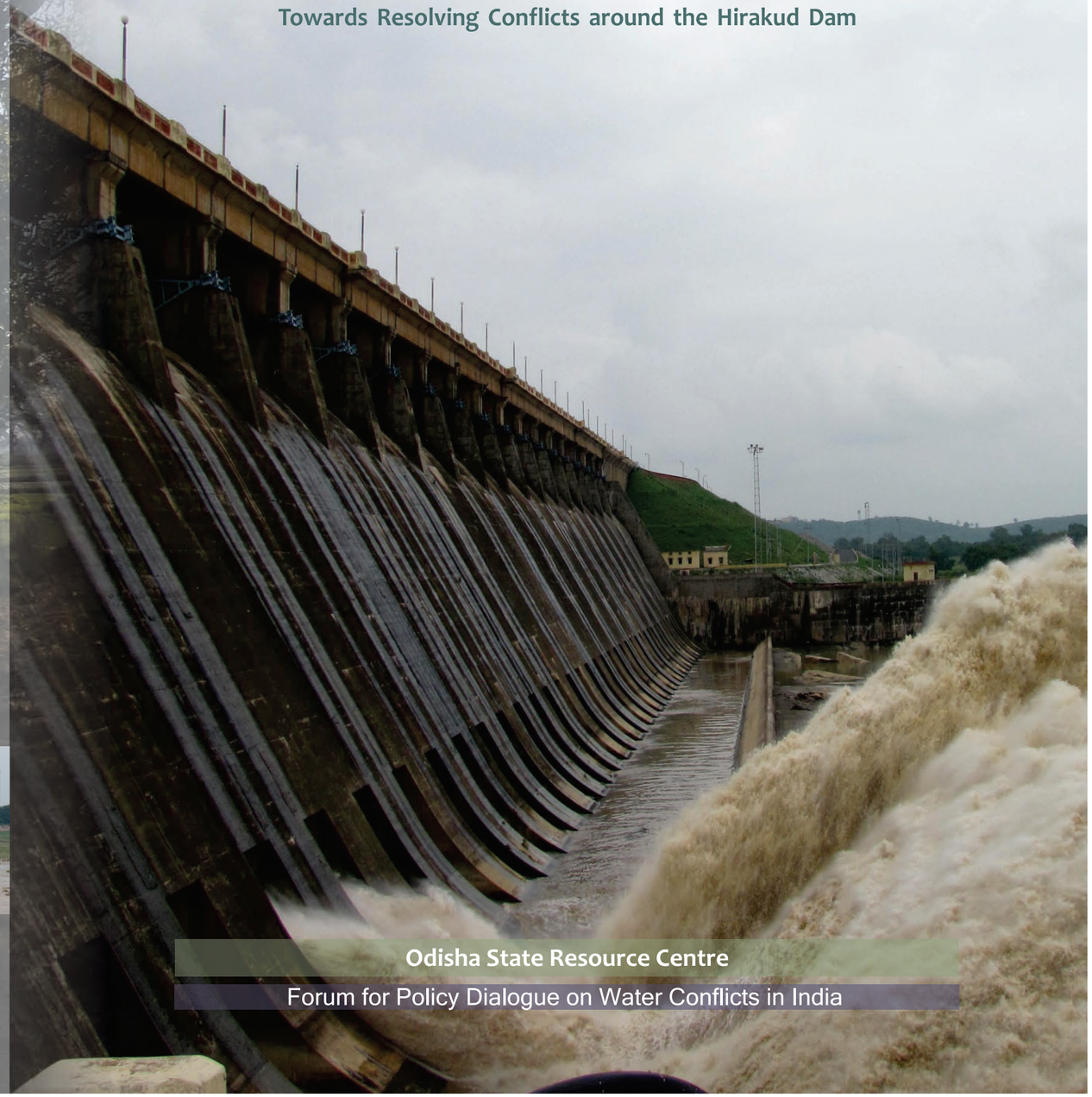
ACTION RESEARCH REPORT

Floods, Fields and Factories

Towards Resolving Conflicts around the Hirakud Dam



Odisha State Resource Centre

Forum for Policy Dialogue on Water Conflicts in India

The Forum and its Work

The Forum (Forum for Policy Dialogue on Water Conflicts in India) is an effort to bring together all those interested in working on issues related to water conflicts in India into a loose network for action and interaction. The Forum began its work towards the end of 2004 as a collaborative effort of a few organisations and independent researchers and was supported by World Wide Fund for Nature (WWF). Presently the Forum has more than 150 organisations and individuals and the present phase of Forum's work is primarily supported by Arghyam Trust, Bangalore. The Forum's work covers the four broad areas of conflict documentation, conflict resolution, conflict prevention and network and outreach.

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Floods, Fields and Factories:

Towards Resolving Conflicts around the Hirakud Dam

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Odisha State Resource Centre

Forum for Policy Dialogue on Water Conflicts in India

FORUM FOR POLICY DIALOGUE ON
WATER CONFLICTS IN INDIA

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Executive Summary

Introduction

In its current phase of work, the Forum for Policy Dialogue on Water Conflicts in India (henceforward, Forum), a network of people and organisations working on water conflicts in India, took up resolution and prevention of water conflicts as a focus area, along with networking and raising awareness and documentation of water conflicts in India. One of the objectives of the Odisha State Resource Centre of the Forum, established at the Baitarani Initiative, Shristi, Bhubaneswar in 2008 in collaboration with the Odisha Water Forum was to engage with the conflicts around the Hirakud dam, especially the industry-agriculture conflict, through action research aimed at contributing towards methodologies and raising awareness for conflict resolution. This action research report is the output of more than three years of that engagement. It maps the variegated issues contributing to the water conflicts around the Hirakud reservoir, brings together the response of policy makers and stakeholders, and suggests options and methodologies for initiating and creating preconditions for resolving the conflict.

The Hirakud dam in Odisha has been viewed as a symbol of India's post-independence developmentalism. The recent conflict is largely seen as one between the farmers in the Hirakud command and the Government of Odisha over the allocation of water from the reservoir to industries. However, the water conflicts around Hirakud are more complex. They are part of a classic contestation over natural resources in fast-developing countries with neoliberal policies pushing reforms and favouring industries and the market, while local communities struggle to maintain their livelihoods and institutions.

Objectives and Methodology

The main objective of the action research was to engage with conflicts around the Hirakud dam, study their inter-relations, and contribute to methodologies for resolving the conflict and raising awareness. The Odisha State Centre of the Forum proposed to do this by interfacing with local civil society groups, social movements and other stakeholders, bringing them together, understanding the other interconnected conflicts around the Hirakud dam, learning from the experience, and raising awareness about the issues.

The methodologies deployed for data collection included data collection from secondary sources, reviews, primary field surveys and observations, in depth interviews and Focussed Group Discussions (FGD) with stakeholders and groups as well as ethnographic studies. Secondary data has been collected from news articles, research papers, government reports/archives, legislations, government policies and other archival data relevant for the project and discussions with experts. Stakeholder dialogues, workshops and consultation and presentations

were utilised for exploring stakeholder perceptions about the conflicts around Hirakud and their resolution.

Stakeholders with whom extensive discussions were carried out individually or in FGDs included the following (figures in parentheses indicate the number of discussions/meetings held): Industries/Corporate houses (3), Farmers – Big, small, and marginal farmers (4), Farmer leaders and activists (7), Academicians and environmentalists (5); Youth and women (5); Government authorities/officials in charge of allocating water (4); Institutions/NGOs (13); Fishermen (7) and Media (7).

Floods and the Building of Hirakud Dam

The Hirakud reservoir was built for flood control in the Mahanadi river delta. The requirements of flood control and other uses often are in conflict: the flood cushioning for flood control requires keeping the reservoir as empty as possible during the monsoon to absorb high runoff; on the other hand, other uses like power, industry and agriculture, require that it should be as full as possible. The Hirakud dam is one of the few dams in India where a flood control cushion has been provided in its storage capacity. However, the storage in Hirakud is limited in relation to the size of its catchment.

The inability of the Hirakud dam to control floods has been well documented in terms of the flow downstream at Mundali, and the damage in the delta in terms of the area affected and damage to life and property by floods. The media and civil society groups attribute this failure to the ineffectiveness of the reservoir, reduced storage capacity, and non-compliance of the reservoir operation with the 'rule curve', to accommodate industrial and power production needs. The dam protagonists point to the lack of a basin-wide approach and the delay in the construction of downstream storage structures and say that without the dam, the delta head would have experienced severe floods, some of which would have wiped out Cuttack and the bulk of the delta area.

Irrespective of the arguments either for or against the dam, with aging, climate change and economic development, Hirakud seems to have failed in reducing the incidence and damage due to floods. Also, importantly, Hirakud's flood control objectives substantially affect the way the reservoir water is allocated spatially and temporally for competing sectors, thereby contributing to the conflict between agriculture and industry.

Water Conflicts around Hirakud

The Hirakud dam has been dogged with conflicts right since its inception. Before construction, it faced the resistance of the people in its submergence area. The agitation grew in strength and snowballed into a demand for the separation of Sambalpur district from Odisha, though it fizzled out in face of post-independence euphoria. After construction, the displaced people by the reservoir, including fishermen, have yet to be fully and properly rehabilitated and compensated. Their

struggle continues. Meanwhile industrial and urban use has been growing, and received a spurt with post-1990 liberalisation. Half a century after its construction, Hirakud conflicts moved to the command areas, where farmers resisted industrial water allocation and intake from the reservoir. The increasing entry of thermal and aluminium industries is transforming the Sambalpur-Jharsuguda region rapidly into the largest conglomerate of smelter and power industrial units in the world. It is unlikely that such fast-paced growth will be sustained environmentally. New conflicts have now emerged around pollution of the reservoir and competition for irrigation water.

The Hirakud Catchment: Changing Conditions and Impact on Inflows

The inflow of water to the reservoir from the catchment in terms of quantity and quality is influenced by changes in the catchment land use and its characteristics. In terms of quantity, it highlights the trends of land development activities in the catchment of the dam, 89.9% of which is situated in Chhattisgarh state, as well as developments in upstream water intake and use by industrial units and other water users. Mining activities, changes in land use pattern in the catchment, and industrial effluents have had important implications for the silt load in the reservoir and the quality of reservoir water. The implications of the changing runoff regime needs to be taken into account during reservoir operation and water allocation and also needs an inter-state dialogue to prevent conflict between Chhattisgarh and Odisha states.

The Hirakud Reservoir: Changing Conditions, Allocations and Incomplete Rehabilitation

The reduction in storage space, availability and quality of water has a direct bearing on water conflict potential in the region. The periodic lack of water availability in lean periods, and sedimentation at the mouth of the Sason canal were already resulting in widespread unrest among the farmers. The allocation of water to industries, and use of water by industries from the reservoir, often in flagrant violation of all norms added to an already unstable mix leading to the 2007 agitation.

Fishing has been severely affected over the years and is another source of continuing conflict between the fishermen and the dam authorities. In addition to the traditional fishermen communities, a large number of displaced persons who have settled around the reservoir are dependent on fishery for their livelihood. Initially, there was very little commercial fishery. Later, in 1960 the Department of Fisheries took over control of the fishery in the reservoir. Decreasing catch, reduction in the variety of fish species, pollution and the increasingly commercial terms the department is shifting to have placed fishermen’s livelihoods under great stress, leading to a continuing conflict which peaked in massive protests in 2010.

The allocation from the reservoir for different uses has also been changing rapidly and is a cause of conflict. Since regulated releases from the dam also generate power, allocation for power production reflects not only power production but also the availability of water for downstream uses, especially urban water use and delta irrigation. The trend has been towards greater allocation to industry, followed by

urban water use at the expense of power generation (downstream use) and irrigation. At present, as the Jayaseelan Committee has said, total industrial use is not large and may not affect allocation to irrigation, but given the rapid rate at which it is rising and the projected needs of the planned industrial development of the region, it may not be long before it does so. Moreover, aggregate values do not tell the whole picture and lean season variations are much more important and in favour of industry while industrial use also has a greater pollution effect in the lean season.

The Hirakud Command: Increasing Shortages, Changing Crop Patterns and Deprivation of Tail Reaches

The Sason canal command was the epicentre of the 2007 Hirakud water conflict. There was shortage in water supply to the Sason command area during 2005-07. It was on the background of this shortage that the conflict broke out, resulting in massive civil disobedience and political ramifications that rocked the Assembly sessions and threatened the basis of the ruling party's power in Odisha. Since then, at least on the face of it, the government has always maintained that it will not allocate water to industries at the cost of water allocation for irrigation. However, the resentment and unrest continue, and can explode at any time into action. There are also other cross currents within the command that are acting upon the major industry vs. agriculture fault line.

Land reforms and land ceiling did not change the land ownership pattern in the command area. A number of landlords in the command area continue to own big chunks of land through *benami* and false records. Most of the land is concentrated in the hands of the upper-castes and unregistered sharecropping and tenancy is rampant. The productivity of *Bahal* lands in the region, identified as the most productive and fertile lands, is falling due to water logging. Land consolidation has largely failed and most farmers continue to cultivate their scattered smaller plots. Field channels are not properly constructed since they have been based on consolidation reports.

After the High Yielding Varieties (HYV) programme was initiated in undivided Sambalpur district with few improved varieties of paddy, monoculture of paddy season after season and use of fertilisers and pesticides has grown. Paddy, which demands much more water than other crops has now grown much beyond what project design had anticipated putting severe stress on water allocation. Most of the increase in paddy is unofficial and in the head reaches while tail reaches have been deprived of water. The lack of a proper marketing system added to the increasing set of problems in the command areas.

In the circumstances the paddy distress movement has found wide spread support and has helped bring together the farmers under one umbrella, masking all the internal conflicts within the movement. It was the well organised and active network of the movement in the command area of the Hirakud reservoir which provided the backbone of the 2007 movement which ended with the drawing of a farmers' line beyond which no industry was to be allowed to draw water from the reservoir. At the same time, farmers from Sambalpur district are now in market

committees, and are participating in the decision making process of the agricultural market system. However, things do not seem to have improved as farmer suicides are now being reported and those too in the irrigated areas of Bargarh and Sambalpur.

The Water Users Associations (WUA) in the command area called Pani Panchayats were formed according to the Pani Panchayats Act, 2002 and Pani Panchayats Rules, 2003. Though this has given farmers some control over irrigation at the lower levels, participation of women, marginal farmers, and land labourers in the Pani Panchayats is marginal while tenants and sharecroppers are excluded entirely. Patriarchy, caste and ethnic discrimination – most landless labourers and marginal farmers are tribals and dalits – also affect participation in the irrigation management in the command area.

Added to this is a lack of proper training and orientation. As a result most Pani Panchayats are captured by local elites and local contractors and influential persons occupy main positions in the Pani Panchayats.

Policy Changes

In the last decade of the twentieth century, liberalisation, privatisation and globalisation, the so-called LPG became the norm for state policies. The shift in the direction and focus of the state government gained momentum in the successive policies of 1992, 1996 and 2001 as they focussed more on higher private investment in large industries and the mining sector, growth of infrastructure, and economic growth.

The water sector reforms began in Odisha after 1991. Adopted in the early LPG influenced reform era, the 1994 policy and the more recent 2007 policy has been critiqued as having been influenced by the World Bank. The state has also prepared an Integrated Water Resources Management (IWRM) roadmap that has been similarly criticised. Many experts and civil society groups have pointed out a number of flaws that extend from the nature of river basin organisations (RBOs) it envisages to the regulatory mechanisms it proposes. The more recent resettlement and rehabilitation (R&R) policy adopted on the background of growing struggles of the project affected does bring about some improvements as does the legal framework for water allocation.

Stakeholder Analysis

Any effort towards resolving conflict is incumbent upon an understanding of conflicts and their causes through conflict analysis, and an understanding of stakeholders through stakeholder analysis. An attempt was made to delineate and analyse the different groups which influence or are influenced by the use and abuse of water from the reservoir, focusing on the Sason canal command keeping in mind the industry vs. agriculture conflict. A value tree analysis was also attempted along with a sociogram.

The major stakeholder groups identified were as follows. The first group was that of primary users, comprising the farmers and the rural youth and women and agricultural labourers. Farmers themselves were not a homogenous group but comprised broadly of big farmers, small farmers and marginal farmers. Caste and ethnic divisions were also significant and were significantly correlated with landholding. Fishermen were another important group of water users. The Farmers' Unions were an important entity by themselves and were perhaps the most central group as far as the conflict was concerned.

The other stakeholders were the various government agencies, among whom the most important were: the canal management and the dam authorities, the command area development authority (CADA). The Pani Panchayats were the main form of interaction between the government and the farmers at a day to day level. The other stakeholder groups were the Panchayat Raj institutions, civil society groups, academicians and environmentalists, the Hirakhand Nagarik Parishad, the print media and the activists. Last but not least, were the industries, which formed an important and powerful stakeholder group.

The value tree analysis as well as the sociogram, shows the highly polarised nature of the stakeholder groups. The polarisation is into three groupings – industries, government agencies and the rest, including the primary users. There is complete isolation and hostility between the industries and the primary stakeholder groups. In view of this industries tend to rely on government agencies alone and bypass public discussions and participation. The government is seen as helping industries bypass formal procedures and accountability as a result of which it loses trust. This is a serious situation and leading to a vicious circle of reinforcement of conflict. There is need to establish trust, especially of the government and initiate open and transparent stakeholder interaction.

Stakeholder Consultations

Under this action research, the state centre tried to engage stakeholders in dialogue processes. However, considering the strong convictions of stakeholders and their adopted stands/positions, it was decided that consultations would be held with each stakeholder group separately. The objective was to share with each group the state centre's conflict analysis with a broader picture of issues influencing the conflict directly and indirectly, and to seek their feedback for a multi-stakeholder dialogue. A committee of experts and key stakeholder representatives was formed at the outset, after obtaining their consent to guide the research team in fulfilling its action research objective. The meeting of the committee on Hirakud water conflict took place on 27th July, 2010 at Sambalpur, to discuss the processes and pathways for the Hirakud action research project.

A 2-day Workshop on "Water conflicts in Odisha: Issues and way forward" was organised on 28th – 29th March, 2011 at Bhubaneswar by the state centre. Environmental activists, thinkers, academicians, government officials, farmer leaders and civil society organisations from different parts of the state participated in the workshop, along with members of the National Steering Committee of the Forum, to discuss the ongoing and emerging water conflicts in different

geographies of the state. The first session exclusively centred on the water conflicts around Hirakud, with an eminent panel consisting of farmer and fishermen leaders, senior researchers and academicians.

A one day farmer consultation workshop was organised by the state centre in Maneswar village of Sambalpur district on 13th October, 2011. More than 53 farmer leaders around Sambalpur district participated. The second farmer consultation workshop was organised by the state centre at Attabira of Bargarh district on 22nd October, 2011. More than 50 farmer leaders around Bargarh district participated in the workshop. A consultation with fishing communities was organised at Pandri village in the Lakhanpur block of Jharsuguda district on 20th March, 2012. More than 50 fishermen from Bolanda village of Pandri gram panchayat participated in this consultation.

Conclusions and Recommendations

Important information disconnects and divides were visible among and across stakeholders. The formation of a shared and commonly validated pool of information would be an important step towards conflict resolution. The movement leaders, who are the key agents for dialogue, lack trust in the government or industry, and the government needs to realise that it needs to gain trust through impartial actions and be seen to move against the blatant violation of rules and norms by the industry. The industry leaders also need to accept this. Only then can the preconditions for a rational dialogue be set up.

Different stakeholder groups are mobilising different normative frameworks and there is an urgent need for a social consensus around the broad framework of norms which can frame a common dialogue based on ethics, the law of the land, and acceptability among stakeholders. There is also a lack of information flow and disconnect between perceptions across stakeholder groups, except among movements of farmers, fishermen and displaced people. Since the last few years, the Water Resources Department of the Government of Odisha, has been sharing a lot of information; but there is also a need to develop a proper information interface. There is a need for a multi-stakeholder forum around the Hirakud dam where people can meet regularly, exchange and verify information, and facilitate communication, most importantly, listen to each other. Only this can lead to innovative, out of the box thinking to explore pathways, minimising the area of contention, and in the best possible scenario, leading to a win-win solution.

The key recommendations include:

Revisiting Promises Made: For the government and the dam authorities, there is a need to systematically revisit and review earlier decisions and promises keeping equity and justice at par if not above economic and efficiency considerations.

Inclusive Reservoir Management Decision Making and Implementation: It is important to shift to an inclusive and transparent decision making process which is accountable to stakeholders, especially in respect of decisions based on scientific and hydrological considerations which may not be immediately apparent to stakeholders. It is also important to monitor implementation of decisions in the same inclusive manner.

Adapting Reservoir Operation to the Changing Context: There is a need to modify reservoir operations to adapt to global climate change as well as hydrological changes and economic activities in the river basin as a whole. However, they cannot be governed solely by LPG dictated 'rational' reservoir operations for maximising economic gains and must take help of modelling options to take account of social and environmental goals as instruments to arrive at a acceptable rule curves in an inclusive manner.

Evolving an interactive water use plan: The measures above will work only if we can increase efficiency and economic gain without sacrificing equity, justice or sustainability. This involves changing the way we use water, the crops we grow, and the institutions we craft around it and accordingly reassess the water requirement for agriculture, fisheries, and other livelihood purposes in the Hirakud command. A number of steps towards this could be suggested. There is a need to disseminate and adopt these water efficient and environment friendly livelihood options. Based on the above, a water use plan should be evolved for agriculture and fisheries with the most effective water use based on the principles of food security and equity. Through regular interaction before every crop season between different users such as farmers, fishermen and officials, the plan could be synchronised as per water availability, lean period, lean season, etc. Priority must be fixed as per the present water policy in the allocation of water during cropping season. Community monitors representing stakeholders should monitor the water use, and changes in water uses and allocation should be shared transparently and regularly. Accordingly, water allocation from the reservoir through different outlets as well as their release to the user site should be monitored.

Piloting an action research programme: However, the real challenge lies ahead, in bringing all this to the ground. What is required is a pilot action research undertaken along these lines. Such a pilot would need to cover not only the technical aspects of water saving but also the institutional mechanisms necessary to bring different water users together to develop and implement a commonly agreed upon plan for the utilisation of water from the Hirakud dam.

Chapter 1

Introduction

1

The Forum for Policy Dialogue on Water Conflicts in India (henceforward, Forum), a network of people and organisations working on water conflicts in India, began in 2004 with major support from the WWF project 'Dialogue on Water, Food and Environment'. Its first phase of work (2004-8) focussed on documentation of water conflicts in India. To follow up, in its second phase (2008-12), while continuing its work on documentation of conflicts, the Forum moved to issues related to resolution and prevention of water conflicts, along with networking and raising awareness. The Forum also decided to engage with water conflicts in the eastern and north-eastern parts of India which were not adequately covered in the earlier phase. The Odisha State Centre of the Forum was established at the Baitarani Initiative, Shristi, Bhubaneswar in 2008 to take up this task in collaboration with the Odisha Water Forum, a network of individuals and institutions concerned about water in Odisha. One of the objectives of working in Odisha was to engage directly with the conflicts around the Hirakud dam, especially the industry-agriculture conflict, through action research aimed at contributing towards methodologies and raising awareness for conflict resolution.

The multiplying requirements for industry and mining in the wake of Odisha's ambitious industrialisation drive has led to tensions and conflicts around allocation and quality of water for drinking, agriculture and livelihoods all around the state. The rapid industrialisation through large mineral-based extractive industries, including iron, aluminium and other mineral extraction, processing, and associated thermal energy generation, is placing increasing demands on water for processing, cooling, and hydropower, while at the same time contributing to its pollution and degradation. The Hirakud dam in Odisha has been viewed as a symbol of India's post-independence developmentalism[1]. While inaugurating the dam in 1957, Honourable Pandit Jawaharlal Nehru had called it one of the modern temples of newly independent India, creating great expectations of its envisaged contributions to the nation's growth and development. He had also said that "*The Hirakud dam project is a work which will not cause more misery to the people, but will bring about an end to their miseries*". However, after only half a century, in the post-reform era, the dam is associated with one of the most intense water conflicts in India -- the contestation around allocations to industry and agriculture.

Exactly 50 years after it was inaugurated, farmers from the command area for whose prosperity the dam was to provide irrigation, stormed the notified area of the reservoir in thousands. They had come to the place where Nehru had gifted them the dam, ironically adopting the same form of civil disobedience which Gandhi had used against the colonial regime. More than 50 farmers were injured by the police lathi charge that took place.

[1] State-led developmentalism of the post-World War II era as described in D'Souza, 2008

The event which rocked Odisha was the culmination of a two year long struggle involving protests, memorandums, agitations, and human chains by the farmers and their organisations over the dwindling allocation of water to the Sason Canal, their lifeline, even as there was increasing allocation to industries. Odisha's industrialisation policy and its quest for rapid economic development had led to increased industrial-water demand and preferential water allocation by the state behind the backs of farmers, which was a violation of its own water policy. To add to this was the visible and blatant unauthorised drawal of water directly from the reservoir by many units. The farmers were agitating against this allocation at the cost of water for agriculture. On 11th November 2007, farmers drew a '*Chasir Rekha*' (farmer line) on the bank of the reservoir at the location where Vedanta Aluminium Ltd was preparing to lift water, thus forbidding any industrial house to extend its pipelines beyond that line. The Congress, the main opposition party, moved a motion in the state assembly alleging atrocities against farmers and diversion of water meant for irrigation from the Hirakud dam to the industry. Yielding to the pressure from farmers, the Chief Minister declared in the Assembly that reservoir water would not be allowed for industries, and that the water would only be released for irrigation, and announced a grant of Rs. 200 crores for renovation of the Sason canal.

With this backdrop, the conflict is largely seen as one between the farmers in the Hirakud command and the Government of Odisha over the allocation of water from the reservoir to industries. Most mass movements around Hirakud have primarily focussed on the allocation and quantity of water from the reservoir. However, the water conflicts around Hirakud are more complex. They involve classic contestation over natural resources in fast-developing countries with neoliberal policies pushing reforms and favouring the market, where local communities struggle to maintain their livelihoods and institutions. There has been increasing dispossession around dams through time (changing allocation and reservoir management priorities with time) and space (the catchment, the reservoir, the command area) in terms of dwindling availability and quality of water for drinking and irrigation for communities. Accumulation of water by industrial, market and powerful forces has been on the rise. The situation exemplifies global debates around water and environmental justice. There is a need for a comprehensive and holistic appreciation of these complex issues by the stakeholders in order to develop 'convergence spaces' for strengthening alternate discourses towards conflict resolution.

There are many intra-sectoral and inter-sectoral conflicts around Hirakud water which intensify the competition over water. In the command area, there is the issue of deprivation at the tail end, with unequal distribution of irrigation water among head and tail reach farmers. Many of the tail end areas have not been receiving water for several decades. There are issues related to crop patterns and their sustainability which affect livelihood and indirectly feed the conflicts. Water distribution at the distributary, minors, and sub-minor level has its own source of conflicts where powerful sections from the village secure water for their own interests and dominant cropping patterns at the cost of the weaker sections. Waterlogging in the canal command, land use change, land degradation and water pollution have affected crop productivity and the sustainability of agriculture, which also impacts farmers disproportionately. With rising amounts of fly ash and other water pollution, there are simmering conflicts around livelihoods of fishermen threatened by these

developments. Fifty years later, while the displacement and rehabilitation issues of the original oustees are still unresolved, the recent appropriation of reservoir accumulated land (budi anchal) by industries and (coal) mining entities is exacerbating the conflict. With the changing political economy and market influences, at the reservoir operations management level, conflicts around reconciling the objectives of flood control, power generation and irrigation are sharpening. With 85% of Hirakud's catchment lying in Chhattisgarh, increasing upstream water appropriation by dams, industries and water harvesting and change in land use, reservoir inflow is diminishing rapidly further accentuating conflict. In the absence of a clear water sharing arrangement, inter-state disagreements are simmering and making conflict imminent.

Since the mass rally of 2007 when the conflict took political centre stage, many academics and journalists have written about the conflict. Most have underlined the importance of the industry versus agriculture conflict, and worked towards making it visible in the mainstream media. However, in most cases, these efforts were limited to showcasing the stands and perceptions of a particular group of stakeholder, mostly irrigated farmers, by an external actor. Apart from the industry versus agriculture conflict, other conflicts around the reservoir as discussed above have hardly been studied and understood. Also, none of them have been taken up with an action research agenda to move towards conflict resolution.

The Odisha State Centre of the Forum initiated an action research study around Hirakud conflicts in 2008 to address some of these methodological gaps, engage directly and critically with the multiple stakeholders of the active conflict, and learn from this engagement. The Centre was already carrying out an extensive study of water conflicts in Odisha covering all its regions. The objective of this action research was to identify, analyse and work towards resolving conflicts on water issues at Hirakud. It proposed to engage with the water conflict at Hirakud by interfacing with local civil society groups, social movements and other stakeholders, bringing them together, understanding the other interconnected conflicts around the Hirakud dam, learning from the experience, and raising awareness about the issues.

This civil society initiative aimed to analyse the existing situation of water availability and policy of water allocation vis-à-vis the demands, to bring out a clear picture of the demand-supply and gaps. Through stakeholder analysis, conflict analysis and stakeholders dialogues, the study attempted a deeper and better appreciation of the context. While understanding these conflicts and moving towards their resolution and/or prevention, the objective was to explore the involvement of well-informed stakeholders along with the facilitation by an acceptable and capable third party institution. For this reason, apart from the peer support of the Forum, the State Centre has been working with the local civil society, farmers and fishermen's organisation, academicians, the government and the media to learn from their experiences and feedback. The State Centre also relies on the guidance of a Local Advisory Committee (LAC) consisting of representatives of these stakeholders, which was specially set up for this purpose.

As part of the study, a conflict analysis framework was developed, shared with key stakeholders and the LAC with an objective to understand the complex situation more

comprehensively. The framework helped to better comprehend and locate issues and factors contributing to conflict in the three dam-geographies, 1) Catchment 2) Reservoir and 3) Command. Secondary data relating to all the three geographies was collected and analysed, and the analysis was discussed with the stakeholders and the LAC. Policy/institutional changes and their influence were studied for their impact on the conflict. The conflict and stakeholder analysis followed standard methods. Perceptions, values, interests, power, and positions of stakeholders were being analysed using both secondary and primary data. Finally, the findings were shared with the stakeholders and their feedback incorporated. Based upon the literature review, action research and multi-stakeholder engagement, certain recommendations have been made which may help towards an analytical appreciation of the complex nature of the conflict, and also help towards resolution and prevention of such conflicts.

This report presents the results of the study along with its recommendation. The report is divided into eleven chapters as follows.

The first chapter provides a brief introduction to the report and the background of the study. The second chapter deals with the methodology adopted for the study. It describes the research framework, objectives, and the methodology and steps involved in carrying out the action research, which included a comprehensive secondary review, conflict analysis, ethnographic surveys in the Hirakud command, stakeholder identification, mapping and consultations, and policy research. The third chapter provides background information about the Mahanadi river and the Hirakud dam, providing basic information focusing on flood control which was its original objective. In the colonial period, the concept of protection from floods in the delta by confining the river through embankments emerged. The failure of embankments in the delta region gave birth to the concept of storage reservoirs on the Mahanadi for flood control. The chapter describes this shift and how with independence, the focus shifted from flood control to multipurpose river valley projects. It also discusses the report of the first advisory committee on the Hirakud dam, and its ability to control floods in the Mahanadi delta region. It concludes by analysing the post Hirakud floods in the Mahanadi and the inability of the Hirakud reservoir to control floods in the river.

Chapter 4 details the various water conflicts that have taken place around the Hirakud dam, their evolution and manifestations. It begins with the conflicts and resistances that took place during dam construction in 1947. It describes how the project was pushed forward in the name of national interest, despite mass agitations by local communities against the dam. It also briefly discusses how the dam has performed over the years in meeting the objectives of flood control, power generation, irrigation, etc. The chapter describes the increasing industrial allocation, the worsening water shortage in the command, and the increasing contestations by farmers. It traces the trajectory of the ongoing industry vs agriculture water conflict, along with a description of other conflicts around the dam water.

The next three chapters describe the situation in the three dam-geographies -- the catchment, the reservoir and the command. Chapter 5 is an attempt to understand the situation in the catchment of the Hirakud reservoir from the perspectives of impact on

quality and quantity of water inflow into the reservoir, which has a strong bearing on water conflict. More than 80% of the catchment of the reservoir is in Chhattisgarh state. The changes in water use and land use in the catchment region have significantly affected water availability, sedimentation and quality in the Hirakud reservoir, factors which are directly connected to the water conflict in the region. The chapter discusses inflow quantity, inflow abstraction in the catchment, dams constructed in the catchment, rainfall in the catchment, land use, interstate relations, inflow quality, silt flow, fly ash and heavy metal contamination, effluent flow and flood inflow.

Chapter 6 describes the issues around the reservoir that influence water conflicts. The conflict around the Hirakud reservoir is linked to different issues in reservoir operation and management as well as displacement and rehabilitation. The chapter discusses the data about reservoir operations and management in present scenarios, issues related to dead and live storage, siltation and silt distribution, quality of water and reservoir pollution, methane emission, climate change implications, fishery and livelihood, reservoir operation and rule curve, allocation of water in pre-1990 and post-1990 periods, the trend in water use by industry, irrigation and drinking water, flood related issues, and rehabilitation and displacement. This chapter attempts to provide an overview of all reservoir issues related to ongoing and emerging water conflicts around Hirakud which have not been discussed and analysed adequately.

Chapter 7 deals with the issues in the command area of the Hirakud reservoir. It is the command area farmers who have led the agitations against industrial water allocation from the reservoir. The chapter describes issues related to irrigation and farming based on direct interaction and ethnographic studies. It attempts to provide an overview of irrigation practices, land reforms, and the situation of farmers and farming in the command area. Any reduction in the water released into the canals for irrigation is often interpreted as diversion to industries by the farmers. The issues in the command region and their perception by farmers are crucial for working towards the resolution of conflicts around Hirakud. This chapter analyses irrigation pattern and management, waterlogging and death of traditional water bodies in the command area, cropping pattern, agronomical issues, use of chemical fertilisers and pesticides, marketing of paddy, economics of paddy cultivation, farmers' suicides, industrial pollution and crop loss, irrigation cess and changes, land use, land reforms and consolidation, water users associations and equity issues. It also discusses how the farmers were organised to participate in big agitations against industrial water intake from the reservoir.

Chapter 8 discusses the changing water policy context in the state and its implications for the Hirakud reservoir. The chapter describes the water sector reforms in Odisha in the context of the Hirakud dam project, and discusses the formation of new institutions for water management such as the Water Resources Board and Pani Panchayats. It provides an overview of the state water plan and its provision for the Hirakud reservoir, briefly describing the changing water governance and the changes in institutions, policies and power relations around the Hirakud reservoir. The chapter ends with a critical look at the reports of expert and technical committees which were appointed by the state government to look into the matter.

Chapter 9 discusses the stakeholders and their role in the conflict. This chapter maps important stakeholders in this conflict and provides an understanding of who they are and what role they have played or are playing in the conflict. It discusses power relations, influences and coordination among the stakeholders. Stakeholders such as the farmers' movement, state government, media, activists, industry and academicians have played important roles in this conflict. The chapter explains each stakeholder group, how it evolved, their interrelations, and the degree of power and interest they hold. It also provides a value analysis table, a stakeholder interaction table and a sociogram to illustrate their interconnections.

Chapter 10 presents the findings from the stakeholder interaction and responses, which the action research tried to elicit through different meetings, workshops and consultations. The project has engaged in a continuous dialogue with different stakeholders involved in the Hirakud water conflict. The responses of different stakeholders during these interactions are presented here. The broad contours of the opinions of stakeholders regarding the Hirakud water conflict can be understood from these responses. This information is crucial for any further work towards conflict resolution.

The concluding Chapter summarises and draws together the analysis and findings of previous chapters with a view to comprehending the complex nature of the water conflict around Hirakud, and the causes underlying it. It goes on to discuss the experiences of the action research team in attempting to bring the stakeholders into a conflict resolution process, and the learning emerging from it. It concludes with a few recommendations for working towards conflict resolution that emerge from this round of action research.

This action research report is the output of more than three years of engagement with the conflicts around the Hirakud reservoir, with an objective to understand, analyse and work towards conflict resolution. It does not have a magic solution to this extremely complex problem, and would not claim to have evolved a clear cut path of conflict resolution around Hirakud. What it does is to map and explain the variegated issues that have contributed to the water conflicts around the Hirakud reservoir. It brings together the response of policy makers and stakeholders, and suggests options and methodologies for conflict resolution that may constitute the preconditions or preparatory requirements for conflict resolution. We hope that it will be useful for policy makers, social movement leaders, civil society, academicians, media and other stakeholders to view the Hirakud conflict through a broader and analytical composite lens for a better appreciation of the conflict, along with ways of understanding and analysing water conflicts in general.

Chapter 2

Research Methodology

2

This chapter explains the methodological framework and process followed in carrying out the action research around the Hirakud water conflict. A combination of methodologies was used for resource based conflict, stakeholder analysis, and exploring stakeholder processes aimed at aiding conflict resolution through mapping of stakeholders, stakeholder analysis and stakeholder consultation. Water conflicts around Hirakud are diverse and issues are interconnected with each other, which necessitates a comprehensive analysis of these conflicts around the dam.

Objectives

The main objective of the action research was to engage with conflicts around the Hirakud dam focussing on the recently emerged Industry-Agriculture conflict at Hirakud, study their inter-relations, and contribute to methodologies for resolving the conflict and raising awareness. Based on our initial understanding and literature survey of the Hirakud conflict, this broad objective is further broken down as follows:

1. To explore and analyse different dimensions of conflicts around Hirakud
   1.a. To identify and establish a typology of the conflicts
   1.b. To critically analyse the industry vs agriculture conflict over Hirakud
   1.c. To explore, capture, understand and analyse the other (interconnected) conflicts around the Hirakud dam

2. To identify and map the stakeholders around the conflicts and to carry out a stakeholder analysis
   2.a. To identify the stakeholders around the Hirakud reservoir focussing on the industry vs agriculture conflict
   2.b. To analyse the relations and interrelationships between the conflicts and stakeholders

3. To reach out to and raise awareness among the stakeholders in the conflict by working with civil society institutions including farmers' organisations and adopting a rights-based approach

4. To organise stakeholder dialogues around the conflict

5. To explore the conflict resolution potential

6. To influence policies for proactive conflict prevention

Methodology

The methodologies deployed for data collection included data collection from secondary sources, reviews, primary field surveys and observations, in depth interviews and Focussed Group Discussions (FGD) with stakeholders and groups as well as ethnographic studies. Secondary data has been collected from news articles, research papers, government reports/archives, legislations, government policies and discussion with experts and other archival data relevant for the project. Stakeholder dialogues, workshops and consultation and presentations were utilised for exploring stakeholder perceptions of conflict resolution.

Participant observation has been used, initially to gain entry and later to collect grassroots information regarding local conditions and perceptions from the area. For this purpose, participatory observation, extensive village stays, canal walks, farm land-transacts and group discussions were carried out. These have helped in developing a grassroots view that has often acted as a supplement and corrective to the information about the general conditions in the area and water allocation and utilisation obtained from secondary and state sources.

Steps in the Action Research

Conflict analysis is an essential component of and is a useful step towards conflict management and resolution. First, an understanding of different dimensions of conflicts was undertaken and strengthened through first hand consultations with different stakeholders, and a literature review about the Hirakud conflict. A conflict analysis tree was developed and was further progressively refined through frequent review as interaction and meetings with stakeholders took place.

After an analysis of Hirakud, its conception and how it is related to flood control, the different aspects of the Hirakud dam and their linkages influencing the conflict around the dam were studied on the basis of their division into the following categories: 1) Catchment 2) Reservoir 3) Command 4) Policy and 5) Stakeholder processes. Often this involved many other issues as well. For example, the study of the catchment made us look at the inflow quality and quantity. The study of reservoir storage, made us look at reservoir management and rehabilitation, while the study of the command led us to water management, conveyance efficiency, delta irrigation and so on. The framework developed for the industry vs agriculture as the main focus of the conflict also had to take into account how other aspects and conflicts around the Hirakud reservoir might indirectly fuel or modify the conflict, or might contribute to future conflicts and a shift in their pattern.

For the catchment area and factors affecting the quantity and quality of the water in the catchment area, some important aspects studied were catchment area treatment plans and measures taken by the respective state governments, conservation projects and their effectiveness, as well as upstream inflow abstractions by the different states. Similarly, for the reservoir storage, quantity and quality of the reservoir storage, operation of the reservoir as per the rule curve and in emergency situations, allocation of water from the reservoir, priority for allocation and the dependency on the reservoir were some of the important aspects studied. For the command area, the

appropriateness of water management in the command, the conflict between the head reach and tail end farmers, its implications, conveyance and water use efficiency, public participation in the water management and the overall water resource management and governance in the command were among the aspects studied. Secondary sources and analysis were supplemented and grounded through stakeholder consultation and review. As regards policy and social movements (farmers' movements), the analysis was based on extensive discussions with direct stakeholders on questions related to policy changes and influences.

Stakeholder Analysis and Dialogue

Stakeholder analysis was conducted through a combination of methodologies that were based on secondary sources and their review, as well as primary surveys employing participant and direct observation. Different tools included value tree[1], 'sociogram', actor linkage matrix, power-interest mapping and stakeholder table analysis.

The stakeholders' value has been analysed with the help of the stakeholder analysis tree. The stakeholder analysis tree of every stakeholder group was drawn up on the basis of their vested interests. At the end, a common value tree was formed to indicate the overall picture of stakeholder interests, power, positions and possible alliances.

- The data has been collected through structured and semi-structured interviews with the stakeholders. A different set of interview guidelines have been designed for different stakeholder groups keeping in mind its specific characteristics.

- The number of stakeholders contacted depended on the type of the stakeholder group, their willingness to participate in the interview, and the scope and limitation of the study.

Focus group discussions have been carried out as per the suitability of the group. Snowball sampling has been used to capture information from a maximum number and diverse groups of stakeholders.

Stakeholders with whom extensive discussions were carried out individually or in FGDs included: Industries/Corporate houses (3), Farmers - Big, small, and marginal farmers (4), Farmer leaders and activists (7), Academicians and environmentalists (5); Youth and women (5); Government authorities/officials in charge of allocating water (4); Institutions/NGOs (13); Fishermen (7) and Media (7).

[1] Winterfeldt 1987 as referred by Boix Fayos 2002.

3

Chapter 3
Floods and the Building of Hirakud Dam

The Hirakud dam, often viewed as a symbol of India's post-independence developmentalism, is the epicentre of the conflict around the project (D'Souza, 2008). Constructed primarily to control floods and ameliorate flood related problems of Odisha, this dam was designed as a multipurpose dam with the objective of contributing to the economic development of newly independent India through power production, irrigation, and provision of water for cities and industry. Later in the neoliberal era, with the availability of cheap power, minerals and water, the dam has become a favourable ground for colonisation by aluminium and thermal power industries. The increasing competition and contestation over water allocation, and the interaction and influence of political and economic perspectives, are poised to accentuate the conflict which had erupted in the past.

From a conflict analysis perspective, it is imperative to understand the background, rationale and processes behind the construction of the dam. It is important to understand the rationale of decision makers in setting up priorities in dam design and management. The main driver behind dam construction being flood control in the deltaic Odisha, this chapter is an attempt to provide the background to the construction, management and effectiveness of the dam from the perspective of flood control.

The conception of the Hirakud reservoir was related to floods in the Mahanadi river delta. The objective of this chapter is to provide an overview of the processes related to floods that led to the genesis of the dam, and an assessment of its success in mitigating floods. Though the conflict has largely manifested as one between industry and agriculture, the issue of floods is difficult to ignore. On the one hand, the flood cushioning required for flood control requires keeping the reservoir as empty as possible during the monsoon to absorb high runoff. On the other hand, other uses like power, industry and agriculture, require that it should be as full as possible. In addition to these conflicting needs, flood-related conflicts are a major issue in Odisha. Every year, during floods, the role of the Hirakud dam in abetting or controlling floods is debated hotly in the media and on political platforms. Therefore, an appreciation of Hirakud from the perspective of floods is essential for understanding and analysing any conflict around Hirakud.

An Overview of the Mahanadi Basin

The Mahanadi basin extends over an area of 141,000 sq km. It lies in the north-east of

the Deccan plateau, covers large areas in the states of Chhattisgarh and Odisha, and small areas in Bihar and Maharashtra. The upper basin is a saucer-shaped depression which is known as Chhattisgarh. The Mahanadi originates in a pool 6 km from Pharsiya village near Nagri town in Raipur district of Chhattisgarh, and falls into the Bay of Bengal near False point, about 16 km below the confluence of the Chitrotpala and the Mahanadi. The total length of the river from the head to its outfall into the sea is 851 km, of which 357 km are in Chhattisgarh and the remaining 494 km are in Odisha. The Seonath, the Jonk, the Hasdeo, the Mand, the Ib, the Ong and the Tel are the principal tributaries of the Mahanadi river.

Table 3.1: Overview of Mahanadi River and its Catchment

1. Catchment Area 1,41,134 Sq km		
	Odisha (Sq km)	65,628
	Jharkhand (Sq km)	132
	Chhattisgarh (Sq km)	75,136
	Maharashtra (Sq km)	238
2. Length 851 km		
	Odisha (km)	494
	Chhattisgarh (km)	357
3. Population (2001) 34,21,612 persons		
4. Forest area 23,020 Sq km		

Conception of the Hirakud Dam

After the devastating high floods of 1937, M. Visveswarayya, was requested by the Government of erstwhile Orissa to advise them on the flood control problem. He suggested multipurpose water reservoirs in the Mahanadi basin to tackle the problem of floods in the Mahanadi delta, after emphasising the great need for a scientific survey and continuous observations of the rivers and the delta. The Interim Report of the Flood Advisory Committee (1938-42) suggested storage reservoirs. The problem was finally referred to the Government of India in 1945. The Government of India subsequently passed it to A. N. Khosla who was the Chairman of the Central Waterways, Irrigation and Navigation Commission, to conduct a detailed investigation of the potential for the multipurpose use of the Mahanadi river. Khosla, after a great deal of study and discussion with the local provincial authorities, came to the conclusion that the construction of the reservoir was the only cure for many of the problems of Odisha, namely flood, droughts, poverty and disease. On the recommendation of Khosla, a conference was held on 8th November, 1948 at Cuttack chaired by Dr. B. R. Ambedkar, the then Minister of Labour in the Government of India. During this conference, it was agreed that a multipurpose river valley project would be constructed on the Mahanadi at Hirakud.

The foundation stone of the Hirakud dam was laid by Hawthorne Lewis, the then Governor of Odisha, on 15th March, 1946. The project report by Khosla was submitted to the government in June 1947. The first batch of concrete was laid by Pandit Jawaharlal Nehru on 12th April, 1948. The project was completed in 1953, and was formally inaugurated by Nehru on 13th January, 1957. The cost of the completed project was Rs. 100.02 crores in 1957 (which also included the irrigation provisions in the delta area). Power generation along with supply for irrigation started progressively from 1956, and the full potential was achieved by 1966. The salient features of the dam are provided in Annexure 3.1.

The Mahanadi has been dammed at Hirakud, at the confluence of the Mahanadi and Ib rivers. Built across the Mahanadi about 15 km upstream of Sambalpur town, the dam is the first post-independence major multipurpose river valley project in India intended for flood control, irrigation and power generation. The project provides for 159,100 hectares of Kharif and 108,385 hectares of Rabi irrigation in Sambalpur, Bargarh, Bolangir and Sonepur districts. The entire irrigated patch of land of the dam is served by two canal systems: the Sason canal and the Bargarh canal. Either canal is of a different type: the Sason canal is of the ridge type and the Bargarh canal is of the contour type. The Chief Engineer, two Superintending Engineers and seven Executive Engineers and their staff are concerned with the maintenance and repair of the dam, with the funds allotted to the Chief Engineer by the state government from time to time.

Floods and Hirakud Dam

The conception of the Hirakud dam was based on the major objective of flood control in the Mahanadi delta.[1] The floods were having catastrophic effects in the delta region, damaging lives, infrastructure and property. Statistics show that in the last 150 years, the Mahanadi has been in flood 130 times.

The investigation and documentation of floods in the Mahanadi, Brahmani, and Baitarani deltas was started in 1868 by the colonial government (Mahalanobis, 1940). In response to the flood problems in the delta region of Odisha, the government appointed a Flood Enquiry Committee in 1927.[2] After investigations in the Mahanadi delta and field visits to the region, this committee recommended that:

1. The construction of a flood control reservoir on any of the rivers was not practical.

2. Some of the estuaries should be opened up and cuts made in places through sand dunes along the sea coast to allow the free passage of flood water into the sea. The embankments in the semi protected areas should also be removed as they obstructed flow and were liable to breaches.

3. Private reclamation along the coast should not be permitted.

4. The Odisha Coast Canal and other coastal canals should be abandoned, as they were not serving the needs of irrigation or transport, but were instead obstacles to the free flow of floods.

5. Irrigation by pumping should be encouraged.[3]

It may be seen that this committee considered that the control of reservoirs was impracticable, and did not recommend any form of embankment because it obstructed floods (GoI, 1947:7).

Floods in the delta region of the Mahanadi have a number of basic geographic reasons which aggravate the flood situation in the region. The coastal region of Odisha has a steadily northward sand drift. This drift forms bars in front of the mouths of rivers in the delta. The drift is raised by hot weather and winds coming from the sea. This has led to unbroken sand drifts across the mouth of rivers. It is very difficult to find a river channel having a straight course to the sea. River flows are diverted due to

[1] Flood conference 1945, Cuttack

[2] The Orissa Flood Enquiry Committee of 1928 was presided over by the well-known Chief Engineer of Bengal, Mr. Adams Williams. (http://www.ambedkar.org/ambcd/44A4.%20Member%20of%20The%20Governor%20General%20PART%20IV.htm

[3] Report of the Orissa Flood Committee 1928, Patna, 1929

this drift, and most of the river courses take a near perpendicular turn and flow in the northward direction almost parallel to the coast for several kilometres before joining the sea (Mahalanobis, 1940). The Flood Committee 1928 report opined that the shorter length of the Mahanadi delta is due to this drift. The deltas of the Ganges and the Indus begin about 643 km inward from the sea. However, the deltas of the Mahanadi, Bramhani and Baitarani begin barely 80 km inward from the sea (Mahalanobis, 1940). Silt deposition for the formation of new land at the head of the delta does take place [at the edge of the sea, but this silt is forced northwards by the littoral drift (Mahalanobis, 1940). Owing to the small width of the delta, the tidal action extends inwards for a considerable distance. During the monsoon season, the sea level rises by up to 2 to 3 feet, reducing the slope of discharging flood water (Mahalanobis, 1940). In this situation, the formation of embankments aggravates floods in the delta. The entire rainfall in the catchment of the Mahanadi, the Bramhani and the Baitarani basins is 30 times more than that in the delta. Therefore, there is pressure on the delta to drain this water to the sea.

In a very clear manner, the Flood Enquiry Committee of 1928 rejected any proposal for the formation of reservoirs on these rivers and the construction of embankments in the delta region.

After the devastating floods of 1936 in the Mahanadi river, the then Orissa government asked Visveswarayya to study the situation and recommend a resolution to the problem.[4] He advised (GoI, 1947:8) that the following information should be collected:

1. Hydraulic data
2. Areas requiring protection
3. Estimates of costs and proposed work including reservoirs
4. Further investigations of flood control reservoirs

The available information indicates the massive damage caused by floods for the period 1910-1938, which is as follows:

Table 3.2: Damage due to Floods in Orissa (1911-37)[5]

Year	Damage (in lakhs Rs.)
1911	30
1919	68
1920	29
1925	23
1926	60
1927	35
1929	29
1933	56.33
1937	29.63
Total	**360**

Visveswarayya did not outright recommend a big reservoir on the Mahanadi for controlling floods in the delta. Instead, he recommended that if a reservoir is constructed, it should have the capacity to hold up flood water temporarily and release it gradually. According to recommendations of Visveswarayya, a Flood Enquiry

[4] In 1937, the enquiry was entrusted in the able hands of M. Visvesvarayya, who submitted two reports- one in 1937 and another in 1939. His work was followed by the Orissa Flood Advisory Committee. The Committee submitted a preliminary report in 1938 and continued its work till 1942, during which period it submitted three interim reports. A later effort in that direction was the March 15, 1945 Flood Conference convened at Cuttack by the Government of Orissa (http://www.ambedkar.org/ambcd/44A4.%20Member%20of%20The%20Governor%20General%20PART%20IV.htm)

[5] Interim Report of the Orissa Flood Advisory Committee 1938-39.

Committee comprising of technical experts and engineers was formed in 1938. This committee recommended the following measures:

1. The control of the discharges and the silt charges at the bifurcations of the rivers,
2. Provision of better outlets to the sea,
3. Adequate strengthening of the embankments and prevention of breaches both in the embankments and in the natural banks, and
4. The provision of high level escapes.

It also recommended that other cheaper options to control floods should be explored, instead of building such an exorbitantly expensive reservoir. After studying other options for flood control and estimating losses due to floods in the region, option of building a dam may be explored. The committee was concerned about the economic burden the project would place on the erstwhile Orissa province.

The Flood Enquiry Committee Report of 1940 recommended the following (GoI, 1947)[6]:

- To improve the river it is necessary
  a. To improve the outfall condition,
  b. To control the distribution of water and sand entry at the heads of channels, and
  c. To restrict the number of channels.

- Without double embankments, deltaic rivers break up and deteriorate. Double embanking in conjunction with other measures retards and prevents such deterioration.

- Double embankments necessitate the provision of high level escapes and the improvement of river channels such that the depth of the spill through these escapes is gradually reduced.

- Control by double embankments and escapes should be combined with suitable drainage of the basins between rivers.

Hirakud and Flood Control in the Delta Region

The decision to construct the dam was taken by the colonial government. The actual construction, however, started only after independence. An advisory committee on the Hirakud dam project was formed under the Central Waterpower Irrigation and Navigation Commission. This committee gave its report on dam construction in 1948. However, some construction work had started before that. It also brought out statistical and other information related to the capability of the Hirakud reservoir to control floods in the Mahanadi delta.

The committee conducted a detailed analysis related to runoff, floods discharge and silt load in the river at Hirakud. It was considered that the mean annual runoff at Hirakud was 50 [7] (Million Acre-Feet (MAF). Dr. A. N. Khosla, who was the consultant engineer for the Hirakud dam project, derived a formula based on the observed maximum flood discharge of 15.7 lakh cusecs at Naraj in the year 1934.[8]

[6] The Project Report of Hirakud Dam Project 1947 explains quotes different flood enquiry committee reports which were a ppointed by colonial government and deliberates on their observations and recommendations.

[7] 39.32 MAF as per Hirakud Project Report (GoI, 1947). Maximum Annual Runoff was 69.822 MAF (1919) and Minimum Annual Runoff was 20.574 MAF (1902)

[8] High flood (devastating flood in the entire Delta) occurs when the discharge at Naraj crosses 14.3 lakh cusec. Embankments in the delta are able to mitigate flood intensity of about 10 lakh cusec at Naraj; During 1982, the discharge at Naraj was 15.82 cusecs (http://www.dowrorissa.gov. in/)

Through statistical analysis, it was determined that the maximum flood discharge at the dam site will be 11,10,000 cusecs. To save land and property in the delta from damage, it was necessary to keep the flood gauge at Naraj at 89.00 feet.[9] Through floods analysis in the delta, it was decided that at least 3.3 MAF water storage should be provided to absorb the extra discharge at Naraj.

This committee accepted the safe flood gauge at Naraj as 90.10 feet. From working tables, the committee explained that "this gauge can be definitely secured in case of a 100 years flood. For a 1000 year flood regulation can be done so as not to exceed a 90.3 gauge at Naraj. Some damage will result but will not be very material. For 10,000 years of flood, however, the regulated gauze at Naraj will 90.8 in spite of the fact that the pond [Hirakud reservoir] will have been raised to the ultimate level of 630.00. Substantial damage will occur in this case but it will have to be faced once in 10,000 years". [10]

[9] Report of the Advisory Committee on the Hirakud Dam Project 1948, page no. 6

[10] Report of the Advisory Committee on the Hirakud Dam Project 1948, page no. 32

Post Hirakud Floods

The Hirakud dam is one of the few dams in India where a flood control cushion has been provided in its storage capacity. The Hirakud dam project was primarily planned for flood control and management. The idea is that the flood cushion portion of the storage should be empty right till the end of the monsoon. However, the storage in Hirakud has a limitation considering the catchment it has. The annual inflow is up to five times the storage. For an intense storm event of 250 mm, a minimum 5 MAF is needed to be released by the Hirakud dam in just three days; the Hirakud spillway would release 13 lakh cusecs during this period.

[11] WRD, Based on table available on website.

The first test for the Hirakud dam came in July 1961, when as much as 1.28 million cusecs of water flowed into the reservoir. At one point of time, the state government even closed all the gates of the Hirakud dam, and the reservoir was full to its peak level of 630 ft. The years 1964, 1967, 1969, 1973, 1976, 1978, and 1980 saw major floods in the Mahanadi. The worst flood came in September 1982, when as much as 1.58 million cusecs was the peak outflow.

After the construction of the Hirakud dam, Odisha has been affected by floods 26 times within 55 years. There have been 20 high floods (> 10 lakh cusec discharge at Mundali) after the dam, and 8 major floods in the period 1958 to 2011. Studies claim that during the period after the construction of the dam, the average inundation period has increased substantially from 1.61 days to 3.17 days.

Table 3.3: List of flood and loss/damage reported 1960-2006[11]

Year	Month of Occurrence	Rivers	Loss/ Damage reported			Loss (Rs. in billion)
			Human lives	Livestock	Land and Public utility	
1960	August	M , Br, Ba, Bu & S	Not available	Not available	7.48 lakh ha	0.117
1961	July – Sept.	M, Br, Ba, Bu & S	Not available	Not available	0.56 lakh ha	0.0254

1964	July-August	M, Br, Ba, R	Not available	Not available	1.64 lakh ha	
1971	July-October	M, Br, Ba & S	26	265	4.68 lakh ha; 95,043 houses	0.317
1974	August	M, Br, Ba, Bu & S	Not available	Not available	5.40 lakh ha	
1980	September	M, Br, Ba & V	82	16669	3.19 lakh ha	0.65
1982	August-Sept.	M, R	126	26359	12 lakh ha	6.16
1984	June-Sept.	S, Br, Ba, M, V, I	27		3.92 lakh ha	
1985	August-Sept.	M, Br, Ba, R & S	22	5281	3.10 lakh ha	
1986	July-August	S, M, I	24	337	1.08 lakh ha	0.55
1991	July-August	S, Br, Ba, M, V	52	1145	6.62 lakh ha	
1992	June-August	S, M, V	43	1397	4.17 lakh ha	1.84
1994	July-Sept.	S, Br, M, V	50		10.17 lakh ha	
1995	May-Nov.	S, M, R V	76	372	16.09 lakh ha	1.12
1997	June-August	M	29	52	5.27 lakh ha	
1999	July-August	M, Br, Ba, R & S	10		1.49 lakh ha	0.54
2001	July-August	M, Br, Ba, R & S, Bu, V, I	102	18149	7.99 lakh ha	8.83
2003	July-Oct.	M, Ba, R, Bu, V, I	92	2956	5.03 lakh ha	10.00
2006	July-August	M, Br, Ba, R, S, Bu, V, I	90	1656	3.10 lakh ha. 0.27 lakh ha sandcast, 1,20,446 houses	20.43

River Code: M-Mahanadi, Br-Brahmani, Ba-Baitarani, R-Rushikulya, S-Subernarekha, Bu-Burhabalanga, V-Vamsadhara, I-Indravati

Flood gauge at Mundali above 10 lakh cusecs is another measure of the flood situation in the Mahanadi delta. It was argued in the 1948 advisory committee report on Hirakud dam project that the dam will be able to control once in 100, 1000 and 10,000 year floods, but that view has now become untenable. There were two floods in 1982 and 2008 during which the maximum discharge at Mundali was above 15 lakh cusecs; the committee had considered that there will be a flood corresponding to 15 lakh cusecs discharge at Mundali alone once in 10,000 years and the regulation by the dam will result in less damage in the delta. However there was a discharge of 15 lakh cusecs two times with severe damage to life and property in the delta region. Flood discharge between 12 to 14 lakh cusecs was recorded 10 times at Naraj after the construction of the dam, though it was considered that such a high level of flood will arise only once in 1000 years. Flood discharge at Mundali was between 10 to 12 lakh cusecs seven times since the construction of the dam, though it was considered that this will happen only once in 100 years and will be controlled by the Hirakud reservoir.

[12] Compiled from GoO (2001), GoO (2002), GoO (2004), WRD and newspaper reports.

Table 3.4: Damage during last 5 high floods[12]

	2001-02	2003-04	2006-07	2008	2011
Peak Flow at Naraj (lakh cusec)	14.08	13.5	13.08	15.82	13.5
Date	20 Jul	30 Aug	31 Aug	18 Sep	11 Sep
No. of Times	Once	Once	Once	Twice	Twice
No. of Districts	24	27	NA	19	19
No. of Villages	18,790	13,404	22,381	8,026	4,897
Population affected (million)	9.68	7.62	8.06	4.5	5.0

Damage					
Human life lost (no.)	102	93	90	96	80
Livestock lost (no.)	18,149	2,956	1,656		
Crop area affected ('000 ha)	799	1,490	309	444	150
Houses damaged (no.)	187,575	185,483	120,446	258,155	116, 706
Financial loss (in millions Rs.)	10,065	15,108	NA	24,543	21,210

The dam planners have not taken into account the potential of the basin downstream of Hirakud to create floods in the delta region. Often, instead of controlling floods in the Mahanadi river, it has contributed to floods. For example, it was reported in the media in 2008 that the height of water in the dam was higher than that recommended by the rule curve committee. When the inflow into the reservoir increased, though there was a flood situation downstream, a sudden increase in the dam water height forced the reservoir administration to release water from the reservoir, which resulted in a man-made flood.

Flood Pollution

During the 2011 flood, the field crops in about 35 villages in Sambalpur, Jharsuguda, Bargarh and Sonepur districts were affected due to fluoride contamination of the flood water coming from Hirakud. The flood water destroyed the crops which decomposed, giving out a rotten smell. Villagers entering the field experienced skin burning and itching. Villagers alleged that during the peak period of the flood, all the industries in the periphery of the Hirakud dam released their effluents into the river, which resulted in crop loss. It may be noted that a desk study carried out by the State Pollution Control Board has indicated that with the proposed industrialisation in the Jharsuguda-Sambalpur region at the periphery of Hirakud, 1,26,000 tons of fluoride bearing hazardous liquid waste would be generated annually, which puts the reservoir under a significant risk of fluoride contamination. This perspective of pollution due to floods, in terms of the additional damage in non-traditional areas near the reservoir, is a new dimension which links the reservoir route flood with the industry-agriculture water conflict, and therefore needs to be analysed and contextualised in stakeholder perspectives.

Conclusion

The media, civil society and alternate discourses have been categorical about the inability of the Hirakud dam to control floods, which has been well documented in terms of the flow at Mundali, and the damage in the delta in terms of the area affected and damage to life and property. They attribute this failure to the ineffectiveness of the reservoir coupled with its reduced storage capacity, and non-compliance of the reservoir operation with the 'rule curve', in order to accommodate industrial and power production needs at the cost of flood control. However, the engineering fraternity and protagonists of the dam point to the lack of implementation of a basin-wide approach[13] and the delay in the construction of storage structures in the lower tributaries[14]. Without the Hirakud dam, its protagonists say, the delta head would have experienced 1.5 million cusecs and 2.09 million cusecs in the floods of September 1961 and August 1982 respectively, which would have wiped out Cuttack and the bulk of the delta area. Another school of thought emerging in reservoir management has shown a

[13] In May 1945, A. N. Khosla, the then Chairman of the Central Waterways, Irrigation, and Navigation Commission (now Central Water Commission), had conceived, for the first time, of a comprehensive plan for the united basin-wide development of the Mahanadi. This envisaged the construction of multipurpose storage dams at Hirakud, Tikerpara, and Naraj.

[14] The Hirakud Dam, with a major objective of flood moderation, intercepts only 83,000 sq km. This leaves almost 62,000 sq km uncontrolled, which primarily contributes to the serious recurring of floods in the Mahanadi delta. Lower Suktel and Lower Indra Major projects with a combined live storage of 577 MCM would enable the peak downstream contribution to be moderated by 150,000 cusecs. The proposed Ong Dam in Padampur in Bargarh district, Burtang Dam in Daspalla in Nayagarh district, and Manjore Dam in Athamllick in Angul district, when completed, can bring down the moderation level of devastation in the delta region by 300,000 cusecs.

lack of appreciation of the changing contexts of climate (shift in rainfall and runoff towards September) and economic development in the catchment in Chhattisgarh and immediately upstream areas in Odisha, namely the Jharsuguda-Sambalpur region.

Irrespective of the arguments either for or against the dam, Hirakud seems to have failed to address the issue of deltaic floods and the resultant damages, which was the reason for its construction. With aging, climate change and economic development, its effectiveness is dwindling day by day, which threatens to increase the woes of Odisha and conflicts around floods. Also, importantly, Hirakud's interaction with flood control also substantially affects the way the reservoir water is allocated spatially and temporally for competing sectors, thereby contributing to the conflict between agriculture and industry.

Annexure 3.1: Salient Feature of Hirakud Dam Project (based on GoO, 2009)

1. General Data	
Name of the Project	Hirakud Dam Project
District/ Tahasil	Sambalpur
River	Mahanadi
Location of Dam	15km upstream from Sambalpur Town; 83^0-52'E Longitude and 21^0-32'N latitude

2. Hydrological Data		
a) Catchments area upto Dam site		83,400 Sq Km
b) Rainfall	Original	Revised(1958-2009)
Mean Annual	1381.25mm	1120mm
Max. Annual	1808.73mm	1928mm(1961)
Min. Annual	940.31mm	691mm(1979)
c) Runoff	Pre construction period	Post construction period
Average Annual (1959-2002)	4.85 MHM/39.32 MAF	3.313MHM/ 26.59 MAF
Max. Annual	8.62 MHM/ 69.82 MAF (1919)	9.09 MHM/ 73.63 MAF.(1961)
Min. Annual	2.54 MHM/ 20.574 MAF (1902)	1.133 MHM/ 9.18 MAF.(2000)
d) Reservoir		
Top of Dam	RL 195.68 m (RL.642ft.)	
Full Reservoir Level (FRL)/Maximum Water Level (MWL)	RL.192.02 m (RL.630 ft.)	
Dead Storage Level	RL.179.83m (RL.590ft.)	
	Original	Revised (2000)
Gross Storage Capacity	6.60 MAF. (8,141 MCM.)	4.78 MAF. (5,896 MCM.)
Live Storage Capacity	4.72 MAF. (5,822 MCM.)	3.91M.AF (4,823 MCM.)
Dead Storage Capacity	1.88 MAF (2,319 MCM.)	0.87 MAF (1,073 MCM)

3. Main Dam	
Total Length	4,840 m (15,741 ft)
Length of concrete & masonry dam	1,148.5 m (3,768 ft.)
Length of earth dam	3,651.5 m (11,980 ft)
Left Earth dam	1,353.3 m (4,440 ft)
Right Earth dam	2,298.2 m (7,450 ft)
Length of Right dyke	10,759 m in one stretch (33,500 ft)
Length of left dyke	9,337 m in five gaps (32,275ft)
Total quantity of earth work in dam	18.10 MCM
Volume of Concrete	0.651 MCM
Volume of Masonry	0.430 MCM

4. Spillway	
Number of under sluices	64 (40 on left and 24 on right)
Size of under sluices	3.658 by 6.20 m each(12 by 20.34 ft)
Sill of under sluices	RL.155.45 m (RL.510 ft.)
No of crest gates	34 (21 on left and 13 on right)
Size of crest gates	15.54 by 6.10 m (51 by 20 ft)
Crest level of spillway dam	RL.185.93 m (RL 610ft.)
Spillway capacity	42, 450 cumecs (15 lakh cusecs)

5 Power Generation		
	Original	Revised
Installed capacity at Burla	4 x 37.5MW = 150.00 MW	2 x 49.5 = 99.00 MW.
	2 x 24.0MW = 48.00 MW	2 x 37.5 = 75.00 MW 2 x3 2.18 = 64.36 MW 1 x 37.5 = 37.50 MW
	Total 198.00MW	Total 275.86 MW
Installed capacity at Chipilima	3 x 24 MW = 72.00 MW	3 x 24 = 72.00 MW
TOTAL	270.00MW	347.86 MW

6 Distribution System				
Number of Head Regulators provided from reservoir for irrigation – 3 Nos.				
Names of Head Regulators	1) Bargarh Main Canal 2) Sason Main Canal 3) Sambalpur Distributary			
Name of canal	Full supply discharge in Cumecs	Sill level of head regulator (m)	Bed widths (m)	Full supply (m)
Bargarh M.C.	108.21	176.98	45.70	2.98
Sason M.C.	17.84	178.38	16.764	1.52
Sambalpur Distry.	3.40	176.52	4.57	0.98

7. Benefit		
A) Irrigation	Hirakud Command (ha)	Delta Command (ha)
Kharif	1,59,106	2,51,000
Rabi	1,08,385	1,14,980
TOTAL	2,67,494	3,63,980
B) Power	1051 MU	

8. Flood Control
(i) Flood at Mahanadi Delta Head controlled to 25,481.31 Cumecs (9.0 Lakh Cusecs) except in grave emergency.
(ii) Flood protected area – 9,50,000 ha in coastal Districts of Odisha.

Chapter 4

Understanding Water Conflicts around Hirakud

4

Since the conception of the Hirakud dam, the region around it has been rife with conflicts. Before the construction of the dam, people in its submergence area resisted their forcible displacement. After construction, the movement of the people displaced by the reservoir, including fishermen who lost their livelihoods, continued to demand their right to proper rehabilitation and compensation. Half a century later, conflicts erupted in the command areas, where farmers engaged in massive protests and civil disobedience against the industrial water allocation and intake from the reservoir. While the conflicts caused by the dam have shifted from its waterspread to command, these conflicts have had different drivers and dimensions, which are connected to larger social, economic, and geopolitical contexts of the state during these times. Of late, new conflicts have also emerged due to the pollution of the reservoir, and competition for irrigation water in its command. This chapter analyses the conflicts around the temporal and spatial axes of the dam.

Protests before Dam Construction

The proposal to build a dam at Hirakud way back in 1945 led to a mass agitation by the people of Sambalpur district. This conflict emerged because the affected communities and their leaders perceived a threat to their lives and livelihoods. The agitation grew in strength and demanded the separation of Sambalpur district from Odisha. However, it ultimately fizzled out with the Congress Party overcoming the resistance, by riding a sentimental wave of post-independence nation building.

Threat Perception of Displacement and the Loss of Agricultural Land

The campaign against the Hirakud dam was launched by the project affected people to resist submergence and forcible displacement. 108 revenue villages in Sambalpur district were expected to be fully submerged by the dam, while 141 villages in the district were to be partially submerged. In addition, 3 villages of Pusar and Saraipali station of Chhattisgarh (formerly in Madhya Pradesh) were to be fully submerged, while 33 villages of the state were to be partially submerged. Also the most fertile tract in Sambalpur district was to be submerged (Nanda and Tripathy, 1987). Hence, the local people opposed the project in large numbers. Local leaders and some ex-bureaucrats played an active role in opposing the construction of the dam. Prominent among them were Bodhram Dube, L. N. Mishra, Prasanna Panda and Sradhkar Supakar. L. N. Mishra pointed to the loss of fertile land of 310 villages and abundant minerals. Bharat Nayak, an ex-deputy minister, rejected the proposed dam in a public meeting, and argued that the displacement would create enormous psychological

problems for those leaving their ancestral homes. He also suggested that due attention must be paid to the improvement of embankments as an alternative to the dam (Nayak, 2010).

Coastal Connection

The minister Radhakrishna Biswas Rai was the first to announce that the construction of the Hirakud dam would save the delta, the most fertile land and thickly populated region of Odisha, from the ravages of flood. The first notification on 13th September, 1946 for the acquisition of land in 95 villages was resisted through strikes in Sambalpur town. This provoked the local people to ask why Sambalpur should suffer for the benefit of the people of the coastal region. They argued that it was irrational to displace a large number of people from Sambalpur district in order to save the prosperous coastal delta from floods (Nayak, 2010).The main question they raised was why the people of Sambalpur district should sacrifice for powerful Cuttack district.

Technical Issues

M. G. Rangaiya, the ex-chief engineer of Mysore, opposed the dam construction on technical grounds, and released a 26-page report which laid out his rationale for opposing the dam.[1] People also protested because they considered the terrain of Sambalpur district to be unsuitable for laying out canals, which would lead to a huge loss of cultivable land, uprooting of people, and destruction of community life (Nanda and Tripathy, 1987). Bodhram Dube pointed out that the flood problem in Odisha dated back to the introduction of canals at Cuttack and Puri. Therefore, a dam would not solve the problem. Further, he argued that the establishment of various industries in and around Sambalpur district would not provide any benefit to the local people. Rather, the rich and the industrialists would reap the benefits, while the local people would be employed as daily labourers (Nayak, 2010).

Demand for the Separation of Sambalpur from Odisha

The affected people participated in several demonstrations, the largest of which was attended by 30,000 people. Their movement grew over time, and finally demanded a separation of Sambalpur district from Odisha. In the last week of May 1947, a *satyagraha* was started under the leadership of Janardan Pujari and his wife Kamala Devi in Sambalpur to stop the construction of Hirakud dam.[2] A series of public meetings were also organised under the leadership of *gountias* (village headmen) of different villages. A resolution was adopted to oppose the project work through a peaceful agitation under the leadership of Bodhram Dube, in order to take steps to separate Sambalpur from Odisha and demand the withdrawal of prohibitory laws. The demand for the separation of Sambalpur from Odisha was an important factor in the organisation of the masses against the dam (Pattanaik et al., 1987: 52-53; Baboo 1991: 2374; Supakar 2004: 10-11, quoted in Nayak, 2010).

The Conflict Fizzles Out

Different explanations have been put forth about why the conflict petered out. The dominant one has been the role of the nationalist and then powerful Congress party

[1] M. G. Rangaiya observed in a report dated 3rd January, 1947 (Nayak, 2010) that the Hirakud Dam as proposed would not fulfil the multipurpose objec tives for which it was conceived. In this context, he stated that the Naraj site was the most suitable place for the dam given that it was being built to control floods. He also argued that the dam would destabilise Odisha's economy, without a proper cost-benefit analysis. As there was no natural waterfall, electricity generation, as he showed, would be prohibitively expensive. He advocated a thermal power plant as an alternative. He viewed the proposed objective of navigation as a doubtful proposition, especially in the context of modern locomotives and changes in the nature of trade and commerce. He also expressed his doubts about the life span of the dam due to the large amount of silt in the river.

[2] However, they were arrested on the first day of the satyagraha. Later, on the third day, Sradhakar Supakar, Prasanna Kumar Panda, Satrughna Panda, Chintamani Hota, Purandar Panda and Srinibas Mishra, were also arrested. Sankar Prasad Mishra, Hari Charan Padhi, Durga Prasad Mishra, Sairendri Nayak, Anantaram Mishra and Ishwar Prasad Mishra made significant contributions to the movement.

which resisted the agitation strongly, because the country was struggling for independence, and there were many divisive tendencies. It was also disapproved by Gandhi (Baboo, 2009). It was this lack of support from the Congress which probably led Khagram to state that the domestic resistance was politically too weak to influence the institutions of India's democratic regime, and either halt or reform the Hirakud project (Khagram, 2004).

Supplementing the explanation that the resistance of the Congress to the agitation led to its end is another theory that locates the reason in the nationalistic rhetoric of nation building in these early post-independence years (Hemadri, 1999). The Prime Minister of India, Jawaharlal Nehru, had in fact once said that dams are the temples of modern India.

Another angle marginally pointed out by Baboo (Baboo, 2009) which has not been highlighted widely, is the branding of protest as an anti-developmental activity which could not gather mass support, as it was led by vested interest like feudal rulers, *gountias* (village headmen or landlords) and elites who were likely to lose most of their land. Other factors which were considered to have contributed to the petering out of the agitation were the arrest of important leaders leading to the closure of communication channels, the casual participation of the people especially of the submergence area, and the sheer disbelief of the people that the rivers like Mahanadi and Ib could ever be dammed (Baboo, 2009).

Nayak has argued that the failure of the Hirakud conflict was due to the absence of NGOs, transnational allied advocacy networks, and legitimised global norms on human rights, indigenous peoples and the environmental lobbies - the factors that supported stronger domestic anti-dam struggles that emerged in India during the 1970s and later (Nayak, 2010).

Conflicts after Dam Construction: Displacement

The Hirakud dam submerged more lands and displaced more people than estimated in the feasibility report. It was estimated in this report that about 168 villages would be submerged, covering 135,000 acres of land including 70,000 acres of cultivated land which would be submerged by the reservoir with FRL (Full Reservoir Level) at 630 ft. (GoI, 1947:315-17) However, by the time the construction was complete, it submerged 325 villages (291 villages in Odisha and 34 villages in Madhya Pradesh) covering 183,000 acres of land, including 123,000 acres of cultivated land. It submerged and displaced about 26,501 families in 249 villages in Odisha that is, approximately 100,000 people[3] (GoO, 2007: 01). This was due to the acquisition of land up to RL (Reservoir Level) 632 feet.

The rates of compensation were much less than the market value.[4] In the process of rehabilitation, the government resettled 2,243 families in 18 different rehabilitation camps, that is, only 8.46% of the total displaced people. Similarly, it replaced 8,468.80 acres of cultivable land, which is 14.52% of the total submerged cultivable land (ibid: 13-15). Lack of proper compensation and rehabilitation by the government forced the displaced people to move to different places to settle themselves on their own initiative.

[3] The exact number of people displaced or affected by this project is yet to be ascertained correctly.

[4] Compensation for lands likely to be submerged proposed in the feasibility report ranged from Rs. 50 to Rs.1,000 per acre, according to their classification in terms of productivity. The land was classified into six kinds (*bahal, berna, barcha, mal, bari* and *at*). However, in reality, they were paid more or less at a rate rang ing from Rs. 200 to Rs.600 per acre, which was much lower than the market value. Similarly, the amount of compensation for submerged houses was too little and insufficient to construct a new home elsewhere. (GoI, 1947: 315-19)

While laying the foundation stone, Nehru, in an address to the villagers to be displaced, said: “If you are to suffer, you should suffer in the interest of the country”. Even after the lapse of 50 years, the cases of compensation are yet to be settled; more than 3500 cases of compensation are still pending. None of the resettlement colonies benefitted from canal irrigation, because the displaced people were not resettled in the command area of the project. Instead they were forced to settle in areas which were previously forested, against all odds. Nor did the meagre compensation enable them to purchase land in the command area. As per the Hirakud Dam Project Report of 1947, there was a proposal to lay three canals lifting 3,824 cusec of water from the reservoir to irrigate 380,500 acres in the upstream areas of the reservoir, where most of the oustees were settled, to compensate for their immense loss. Later, in the Report of the Advisory Committee of 1948, this area was reduced by two-thirds to 100,000 acres. In the Report of 1953, the lift irrigation was totally omitted on the ground that it was uneconomical (Evaluation Committee Report, 1962). As per the report, the lift irrigation potential proposed originally was available, but was not deemed to be economical considering the cost of power including transmission.

The additional land acquired between RL 630 ft and RL 632 ft was distributed among various agencies including the Central State Farm (Hirakud), Jharsuguda which was allotted 10,000 acres.[5] Residents of the villages falling between these contours were allowed to live there, but without any rights, according to retired professor Durga Nayak, whose research on displacement due to Hirakud is well known, in 1970, there was an agitation against the government effort to lease this farm to a Russian company for the production of seed. Most of the oustees who didn’t get farmland in compensation encroached on this farm and cultivated it. The resettled villages are yet to be declared as revenue villages, leading to their being deprived of a number of schemes. There were 21 non-revenue villages in the peripheral areas of the reservoir that did not have their own land. The land which they cultivated either belongs to the Jharsuguda farm or to the Water Resource Department, which still holds all the surplus land without putting it to any use. Though there is a provision under the Orissa Land Reform Act for the settlement of land in the names of possessors who are in possession of the land for more than 12 years, these lands have not yet been regularised in the tillers’ names. The Budi Anchal Sangram Parishad (Submerged Area Struggle Council), an organisation of the displaced villagers, has been fighting for their rights since then. Recently, in 2011, the State government declared that it will conduct a comprehensive survey of the villages falling between these two contours, and record the rights in favour of the villagers instead of the Irrigation Department. However, the Parishad leaders are not very optimistic.

[5] The farm was established by the Government of India in 1967. It was proposed to develop farming in and around the periphery and the shores of the reservoir. The objective was to produce hybrid seeds of maize, wheat, and vegetables, in order to meet the increased requirement for seeds during the fourth five year plan (1969-74) (Senapati and Mahanti, 1971:160)

Conflicts after Dam Construction: Reservoir Fishery

In the beginning, fishing was not allowed in the reservoir. However, about 5000 families of the displaced community who were resettled on the periphery had no work, and were compelled to choose fishing as their occupation. Later, the dam authorities divided the reservoir area of 743 sq km into six sectors and began to lease them out. After an agitation of fishermen under the leadership of Mr. Prasanna Panda, the Government of Odisha created cooperative societies of the fishermen and leased out the six reservoir sectors to six cooperative societies. There are five cooperative

societies operating now. In 2004, a new reservoir fishing policy was developed by the state which increased the leasing tariff and brought in provisions which made fishing by these communities difficult and highly unviable. While these cooperatives follow the fishery policy in the reservoir, the increasing number of outsiders and the mafia ignore the policy and indulge in massive illegal fishing. With the growing number of industries, the concentration of contaminants, especially mercury, chlorine, fluoride, and fly ash in the reservoir water has also increased, affecting the fish diversity and catch significantly. The reduced inflow, increase in uptake by industries from specific locations, increasing siltation, and changing spatial spread with seasons are also acting against the fishermen eking out a simple livelihood. The cooperatives have submitted a memorandum to the government in 2001 in this regard, and accordingly, a high level meeting of the local civil administration, forest and fisheries departments of the three districts was conducted to chalk out an action plan for increasing the fish production capacity of the reservoir along the lines of similar efforts in Andhra Pradesh. However, the situation of these communities continues to be grim.

Industry vs Agriculture Conflicts: Allocation to Command

On 26th October, 2006, more than 30,000 people formed a long human chain from one end of the dam to the other (from Burla to Hirakud) to draw the attention of the government towards water use by industries. On 6th November, 2007, there was a call for a civil disobedience rally at Nehru Minar, Burla, against water use by industrial units. During this rally, the police *lathi*-charged the farmers gathered for a peaceful protest, wounding many. In the aftermath of the police action, the agitated farmers have constructed a Farmers' Wall which prohibits the industries from accessing the reservoir water.

Unlike the period before dam construction, the Congress party, which was now in the opposition, organised a large farmers' meeting at Sambalpur over the issue of Hirakud water on 2nd December, 2007. This incident rocked the 2007 winter session of the State Assembly, during which the Congress stalled the proceedings of the House. Finally, the speaker had to adjourn the assembly *sine die*. In the meantime, the Chief Minister had issued a statement that the interests of the farmers would be protected at any cost. The leaders of the farmers' organisation demanded a total scrapping of all water deals with industrial units. In order to gain a political edge, the Congress party organised a farmers' meeting and rally to put the ruling party at a disadvantage.

The lack of water flow into the Sason canal in 2005, even two years after the closure of the canal due to renovation work, was driving the conflict. In the absence of irrigation for two years, the farmers had already faced severe economic and social losses, with some farmers forced to work for daily wages, and some even having to sell off their land. In 2003, starting with the rabi crop season, the canal was closed for the next two years to undertake repair and maintenance work with a funding of Rs. 32 crores received from the Accelerated Irrigation Benefit Program (AIBP), in response to a long standing demand. The poor quality of repair work had led to farmers' protests, and a presentation of a memorandum to the government. The farmers' union had written to the Chief Minister and concerned authorities about this matter, explaining the inferior quality of canal renovation work. There was no response from the government, and the work continued to be of poor quality. The farmers were especially concerned about the

lack of attention by the contractors to stretches that needed renovation the most. After two years of hardship, in June 2005, though the local newspaper reported the release of 600 cusec of water for irrigation, the farmers could not see any water in the canal. At this point, the desperate farmers approached the Collector. It was discovered that Bhushan Steel had blocked the flow of the Ib River by an embankment in the reservoir to lift water, because of which no water entered the Sason canal. As a result, the agriculture on 24,280 hectares, and the livelihoods of 60,000 families, was under a serious threat. Later, when the embankment was subsequently broken and the silt dredged, a surge of water entered the Sason canal, but because of the poor quality of work, the canal caved in at many places. The water supply to the canal was stopped by the administration again for repairing the damages. This led to the eruption of farmers' protests against the government and industrial water allocation. The industrial water intake had peaked after 2005, when two big units, Vedanta alumina and Bhushan Power and Steel, started to lift water from the reservoir.

These incidents triggered intense anger among the masses. On 24th October, 2005, the Sambalpur Krushak Sanghatan and farmers conducted a relay fast in front of the Collector's office for 28 days. On 22nd November, 2005, the farmers organised a *dharna* in Sambalpur. In response, the Chief Minister announced the formation of a technical committee to resolve the issue. Despite these announcements, the functioning of the canal did not improve. On 15th August, 2006, the Western Odisha Farmer's Movement Coordination Committee planned a number of agitations against state government on this issue. As a part of these agitations, nearly thirty thousand farmers formed a human chain around the reservoir on 26th October, 2006. The farmer union organised a Chetavani Samavesh in Bargarh on 10th January, 2007 to question the elected representatives regarding this issue. The main objective of the gathering was to ask the representatives what they had done for resolving the irrigation water problem of farmers in the region, and why they had not opposed the industrial water allocation from the reservoir in the State Assembly.

Farmers from the command area were in the forefront of this conflict. Their organisations and movements had successfully lobbied against the distress sale of paddy by farmers of irrigated commands of Hirakud earlier. They saw the situation as a platform to unite all farmers and their movements in western Odisha. The Congress saw this as an opportunity to shake the ruling Janata Dal. This movement also drew strength from the evolving dissent against the state-sponsored massive mineral-based industrialisation and appropriation of its rich natural resources, which seriously curtailed the rights of local communities to their land, forest and water.[6] The regional media, academia and intelligentsia extended their full support to the movement and cause of the farmers. The conflict largely became an anti-industrialisation drive by the farmers who were beneficiaries of irrigation. They perceived a serious threat from the growing industrialisation around the Hirakud dam, and the state preference to allocate water to industries. Unlike other dam movements, the support of NGOs, transnational allied advocacy networks, legitimised global norms on human rights, indigenous peoples and the environmental lobbies did not contribute much to the social movements around this conflict. What mattered most was the large participation of the farmers' movement of western Odisha, the rallying of the Congress party behind it, and the uniting of western Odisha'a political leadership around the conflict.

[6] The road map to the appropriation of its rich natural resources through neo-liberal 'industrialisation' is primarily geared towards the so called "harnessing Odisha's vast natural resources". This state has almost 60% of India's known bauxite reserve, 25% of coal, 98% of chromites, 28% of iron ore, 92% of nickel ore, and 28% of manganese. There have been successful mass movements (BALCO Hatao in Gandhamarden in Bolangir, against TATA in Gopalpur, Ganjam district, against the Interim Test Range at Baliapal) as well as continuing ones (against Utkal Alumina in Kashipur and POSCO in Balithuth) against state sponsored industrialisation. These movements have drawn media attention and massive support following brutal actions by the state to suppress them. There were cases of police firing at Sindhigaon, Gopalpur in 1997, where people protested against the proposed steel plant by the Tatas; at Maikanch leading to three tribals in December 2000; at Kalinga Nagar on 2nd January 2006 where 12 people died protesting against the Tata project.

Industry vs Agriculture Conflict: Pollution

The increasing entry of thermal and aluminium industries is transforming the Sambalpur-Jharsuguda region rapidly into the largest conglomerate of smelter and power industrial units in the world. It is unlikely that such fast-paced growth will be sustained environmentally. The total industrial effluent released into the Mahanadi at Sambalpur is 736 KLD (Kilo Litres per Day). Several medium and small industries in the entire Mahanadi basin discharge 100,000 cubic meter of waste water every day. There are a number of other industries proposed in this river basin. The effluents of the Vedanta project carry 6.5 mg per litre of fluoride, after the effluent from the ash pond and smelter project enter the streams, they are likely to have harmful effects on the people of these areas, their livestock, and cultivated crops. The polluted water of the Bheden and Kharkhari is no longer suitable for aquatic life, thus robbing the people of another means of livelihood. This polluted water directly flows into the reservoir and degrades the water quality.

During the flood in September 2011, crop loss was reported due to fluoride contamination in some 35 villages in Sambalpur, Jharsuguda, Bargarh and Sonepur districts. Rotting of standing crops resulted in a strong stench. Villagers entering the fields experienced skin burns and itching. After the farmers agitated, the district administration asked the State Pollution Control Board to submit a report on this issue. The villagers allege that the crop loss is due to the release of fluoride rich liquid waste directly into the river by industries like Hindalco during the flood. In the absence of a supportive report, the affected farmers have not received any compensation. Farmers from Bujatal village of the same region have faced total crop loss, reportedly due to pollution by Hindalco for the fourth time in the last two years.

Farmers and fishermen have been alleging threats to their livelihoods due to pollution by growing bauxite and thermal based industrialisation around Hirakud. Their organisations and movements have been protesting against the pollution of the reservoir.

As per the Report of the Jeyaseelan Committee, a high level technical committee to study various aspects of water usage for the Hirakud reservoir, the disposal of wastes, environmental safeguards, and acceptable quality of any water returned to the reservoir shall be monitored by the Pollution Control Department or concerned agencies (GoO, 2007). The Hirakud dam authorities have now started investigating the matter. Dam officials have contacted the regional pollution control board and the deputy director of agriculture of Sambalpur and Bargarh districts in this regard. The investigation was prompted by a direction of the Odisha Human Rights Commission (OHRC), which asked the dam authorities to submit a report on the issue.

Conflicts in Agriculture: Command Conflicts

The area under rabi cultivation has significantly increased in the villages situated at the head end of the distributaries. Most uplands including village commons like the *gochar, gram jungle*, and *kata* areas are now being cultivated by villagers. Unauthorised cultivation on government lands, canal acquired lands, *gram jungles*, *gochars* and *katais* (Village Common Pasture land, Village forest and traditional irrigation tanks, respectively) account for 10% more total ayacut for which water is now

being used. There is no regulation in place for controlling such land and land use conversions, leading to the increased use of irrigation water in the head reaches. Such increase in the irrigated area in the head reaches has led to a decrease in the ayacut area at the tail end.

With irrigation water coming in, farmers outside the region, especially from the East Godavari district of Andhra Pradesh, came and purchased farm lands. Similarly, within villages too, there is perceptible iniquitous distribution of land, due to the legacy of the land revenue system of the colonial period based on intermediary landlordism. All this has led to an accumulation of irrigated land with a handful of owners, many of whom are absentee landlords. This has increased share cropping practices and dependence on agriculture labourers from outside.

Though land consolidation has taken place, farmers often disagree with the Survey and Settlement reports. They are still cultivating their old patches, though they are paying cess according to the settlement reports. Laying of field channels is difficult without farmers agreeing to consolidate and allow area for this purpose. This is preventing better water management and abetting the perpetuation of flood irrigation.

In absence of field channels and irrigation infrastructure, the tail end region of every minor canal, sub-minor canal and distributary is receiving less water for irrigation than planned. The continuous flood irrigation consumes more water than design requirements. During winter paddy cultivation, farmers are forced to spend nights in the fields to get irrigation water. There are quarrels, direct fights and conflicts related to irrigation water supply. There are major conflicts between villages which are located along the same distributaries.

The irrigation administration, according to a notification of the Water Resource Department, built cross bunds on minor canals, sub-minor canals and distributaries during winter irrigation. To allow adequate water in the head areas which have now increased due to conversions and change in cropping patterns, these cross bunds stop the flow to tail regions at a particular distance. In the downstream of the cross bunds, the government does not ensure irrigation security to farmers. At present, nearly every distributary and minor canal of the Sason canal has such cross bunds. After agitation by farmers' unions, farmers have started using the water beyond the cross bunds. After cross bunding, the revenue administration is not supposed to collect winter harvest cess from the farmers. However, there are instances of cess collection from fields which are located in the downstream of the cross bunds.

Chapter 5

The Hirakud Catchment: Changing Conditions and Impact on Inflows

5

The resistance to the Hirakud dam could be justified on the ground that none of the four objectives of the dam – flood management, hydropower production, irrigation and navigation – have been fulfilled even fifty years after its construction, as Nayak et al have argued (Nayak, 2010). However, the dam authorities, government and many researchers have praised the many benefits of the Hirakud dam for the nation and the state in complementing development. These contradictory views constitute the background to this study of the different aspects of the reservoir, the quality and quantity of water in the catchment and the reservoir, management of the reservoir, water allocation in the command area, associated problems, and the causes of conflict. It also provides an analytical background for the resolution of the conflict, and for the action research which was subsequently taken up.

Over half a century after the construction of the dam, its catchment, reservoir and command have undergone considerable economic and ecological changes. These changes have significantly affected water use and availability, both in terms of quality and quantity, as well as inflows into and outflows from the dam. Changes in management priorities of natural resources in these different spaces have had a strong impact on the evolution and manifestation of the water conflicts around Hirakud, including the industry vs agriculture conflict. The situation in respect of the catchment, the reservoir itself and the command are dealt with in this and the next two chapters.

This chapter analyses the changing conditions in the catchment that have impacted the reservoir. It analyses the inflow of water to the reservoir from the catchment in terms of quantity and quality, as influenced by changes in the catchment land use and its characteristics. In terms of quantity, it highlights the trends of land development activities in the catchment of the dam, 89.9% of which is situated in Chhattisgarh state, as well as developments in water intake by industrial units and other water users. Mining activities, changes in land use pattern in the catchment, and industrial effluents have had important implications for the silt load in the reservoir and the quality of reservoir water. This section also points out the implications of the changing runoff regime on reservoir operation, water allocation and the consequent possibility of an inter-state conflict between Chhattisgarh and Odisha.

The catchment of the Hirakud dam extends over an area of 83,400 sq km, which is 58.9% of the total catchment area of the Mahanadi basin, and lies in the states of Chhattisgarh (74,970 sq km - 89.9%) and Odisha (7,400 sq km - 8.8%) with small portions lying in Madhya Pradesh (130 sq km), Maharashtra (250 sq km) and Jharkhand (650 sq km) (GoO, 2007). The catchment of the Mahanadi can be broadly

classified as an upland plateau. It is an undulating upland tract, sloping generally from the north to the south, and much broken up by rugged ranges of hills. The elevation falls from Reservoir Level (RL) 173.73 m in the north to RL 146.34 m at Sambalpur. The Seonath, the Hasdeo, the Mand and the Ib on the left bank, and the Pari and Jonk on the right bank, are the principal tributaries of the Mahanadi above the dam. Inflows into the Hirakud reservoir are mainly contributed by 6 upstream sub-basins: 1) Upper Mahanadi, 2) Seonath, 3) Hasdeo, 4) Jonk, 5) Mand and 6) Ib.

Inflow Quantity

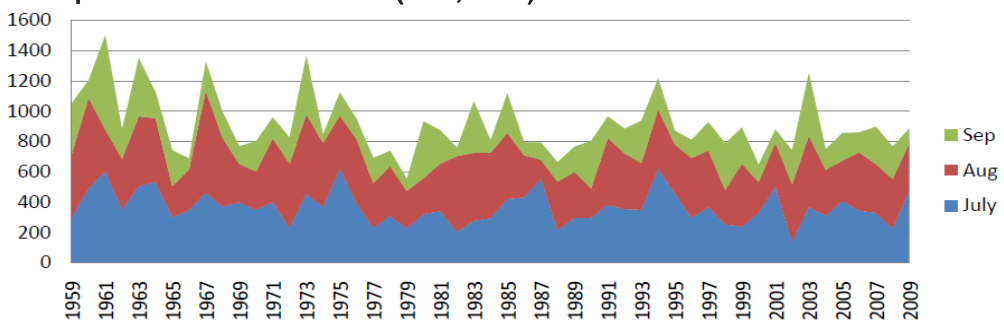
Rainfall

When the original project report for the Hirakud Reservoir was prepared in 1947[1], the mean annual rainfall above Sambalpur was 1381 mm (maximum and minimum being 1809 mm and 940 mm). In the revised project report (1953)[2], the average, maximum and minimum rainfall over the Hirakud catchment worked out to 1369 mm, 1804 mm and 889 mm respectively, considering data over 61 years from 1891 to 1951. The average monsoon (June to October) rainfall in the Hirakud catchment in the post Hirakud period from 1959 to 2006 is 1142 mm, which is about 90% of the total annual rainfall (1270 mm)(GoO, 2007). The monsoon rainfall between 1959 and 2006 shows that the 75% dependable rainfall of the Mahanadi catchment up to Hirakud is 934.33 mm (*ibid)*.

The State Water Plan (SWP), prepared by the government in 2004, refers only in passing to the "variable runoff" with regard to the Hirakud dam and flood vulnerability. It observes that the "variability of monthly rainfall is increasing, which means that rainfall is concentrated in a particular period" (Orissa Water Planning Organisation, 2004). Many notable changes have been observed with regard to rainfall, river flow and flooding over the past few years. The number of rainy days is decreasing. A study by noted atmospheric scientist Professor U. C. Mohanty reveals that the number is dropping by one every five years. On the other hand, the number of days of very heavy rainfall has increased considerably.

Because the number of rainfall days has decreased and the monsoon has begun retreating earlier than usual, the Central Water Commission (CWC) and dam management have decided to keep the reservoir at its full reservoir level (FRL) much before the normal retreat of the monsoon. Climate change may also make the rainfall more erratic, as discussed below.

Fig. 5.1: Monthly rainfall (mm) in the catchment of the Hirakud dam during July, August and September from 1959 to 2009 (GoO, 2009)



[1] According to the data collected from 23 rainfall stations above Sambalpur and 16 below Sambalpur town next to construction site of Hirakud Reservoir during the years 1902 to 1919. Reported in GoI, 1947.

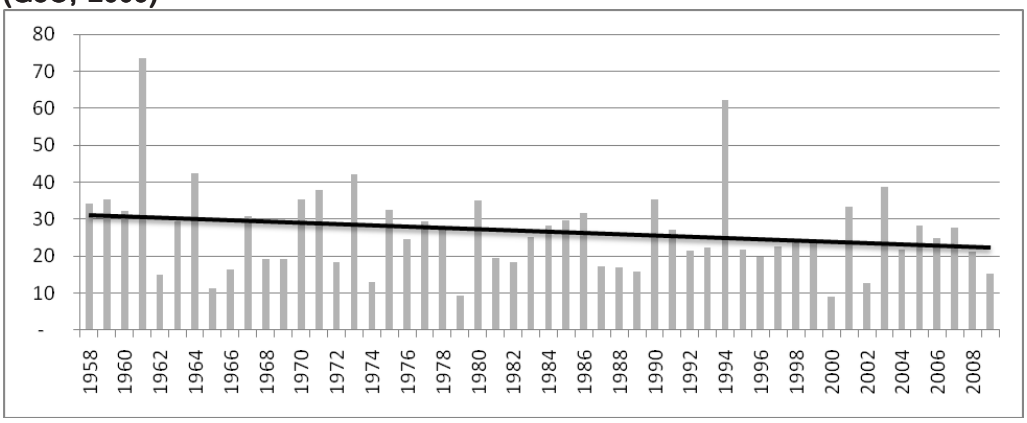
[2] According to the data from total of 105 rain gauges, out of which 66 were in the catchment above Sambalpur town and 39 in downstream of Sambalpur town. Reported in GoI, 1953.

Runoff

The runoff from rainfall over the years varies between 54.78% of rainfall (maximum recorded in 1961) to 17.95% (minimum recorded in 2002). The monsoon rainfall between 1959 and 2006 shows that the 75% dependable runoff at Hirakud is 298.51 mm (corresponding to an inflow of 20.18 Million Acre-Feet (MAF)), and that the runoff to rainfall ratio is 31.95%.

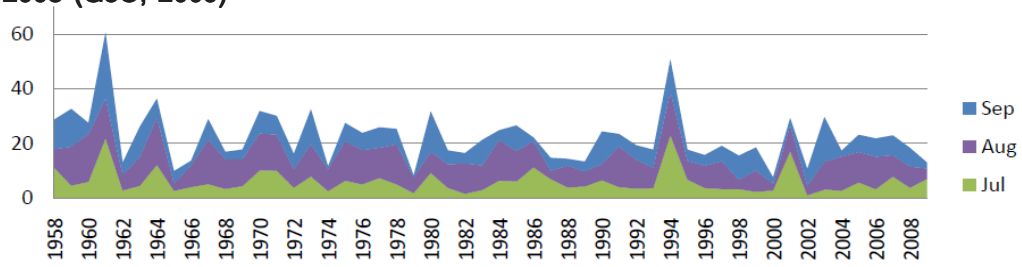
The average annual runoff into the reservoir has been 33,000 Million Cubic Meters (MCM) (27.00 MAF). In the past 25 years, from 1982-83 to 2006-07, the average annual runoff has been 25.32 MAF (an average inflow of 21.72 MAF during the monsoon period, and the remaining 3.60 MAF during the non-monsoon period). The 75% dependable runoff for the non-monsoon period works out to 1.98 MAF (GoO, 2007).

Fig. 5.2: Changing annual inflows into the reservoir (MAF) from 1958 to 2008 (GoO, 2009)



The data show that water inflow into the reservoir has reduced. There has been a decrease in annual inflow, from 30 MAF to about 22 MAF, as well as in monsoon inflow into the reservoir, from 26.5 MAF to 23.4 MAF during 1958 to 2008 (See Figures 5.2 and 5.3). During monsoon months, there has also been a shift towards greater inflow in September (See Figure 5.3).

Fig. 5.3: Changing monsoon month inflows into the reservoir (MAF) from 1958 to 2008 (GoO, 2009)



It is recommended that the reservoir inflows should be greater than 15 MAF. In 1965, 1966, 1979, 1987, 1996, 1997, 2000, 2002 and 2004 the water inflow into the reservoir was in the range of 9 to 16 MAF. According to the rule curve for reservoir operations, the filling of the reservoir should start from the first of August, and before this date the dam water level should be low enough to absorb flood water. By the end of the monsoon, it is necessary to get adequate runoff for filling up the reservoir up to the full

reservoir level (FRL). However, since 1991, the dam was not filled up to the FRL at the end of the monsoon in six years (GoO, 2009, Statement no. 13).

While the Jayaseelan committee has estimated that there is almost no change in inflow values at 75% and 90% dependability in their monsoon total flows (GoO, 2007), another estimate indicates that the dependable inflow into the reservoir is falling at 5% per decade, at which rate, by 2025, it will fall to about 8 to 10 MAF.[3] While there has been spillage of water from the Hirakud reservoir in the monsoon months during all the years of the existence of the dam, the dependable inflows during non-monsoon months are critical for meeting the targeted water requirements for various sectors such as irrigation, hydropower generation, municipal water needs, industrial water supply, fishery, and other uses. The Jeyaseelan committee has also found that these non-monsoon inflows (October – May) for the later 25 years (1982 – 2006) have increased, and has attributed this to changes in land use, and some changes made in the reservoir elevation – capacity curves from time to time and increasing return flows from projects constructed upstream (GoO, 2007).

[3] Retired chief engineer of Odisha, Dr. Bishnu Prasad Das, had raised a serious concern that by 2025, the dependable inflow to the reservoir will fall to as low as 8-10 MAF. According to Das's estimate, the water flow to the reservoir from Chhattisgarh is falling at a rate of 5% a decade. Quoted in Genesis of Crisis, Down To Earth, 31st Dec 2007, http://www.downtoearth.org.in/node/7038.

Table 5.1: Changes in reservoir inflow dependability (GoO, 2007)

Sl. No	Time Period	Average inflow (MAF)		75% dependable inflow (MAF)		90% dependable inflow (MAF)	
		Monsoon	Non-monsoon	Monsoon	Non-monsoon	Monsoon	Non-monsoon
1	1982- 2006	21.715	3.601	16.468	1.980	12.381	1.562
2	1959-1981	25.547	2.750	16.174	1.342	11.603	0.690

Water Resources Development Projects and Industrialisation in the Catchment

After 1957, the Madhya Pradesh Government focused on the construction of a number of dams in the Mahanadi basin for drinking water, irrigation and industrial water supply. During the construction of the Hirakud Dam, there was no bi-partite inter-state agreement between the state governments. In a meeting held at Pachmarhi on 15th June, 1973, the Madhya Pradesh Government argued that they had full rights to irrigate at least 50% of culturable area[4] of the Mahanadi basin in the Chhattisgarh plains.

[4]According to the minutes of the meeting of Madhya Pradesh and Odisha Officers of Electricity and Irrigation Departments held at Pachmari on 15th June 1976 (OWPO, 2004).

Accordingly, a number of major, medium and minor water resource projects have come up in the upper catchment, leading to a changed inflow pattern at the dam site. Apart from five major and medium projects[5], about 150 small dams have been

[5] The Ravishankar Sagar Project (RSP) dam was constructed in 1978 on the Mahanadi river. It is a multipurpose reservoir which serves the purposes of irrigation, hydroelectric power generation, and the industrial requirements of the Bhilai steel plant. The Dudhawa reservoir is situated across the Mahanadi river near Dudhawa village, about 21 km west of Sihawa near the origin of the Mahanadi river. The construction of the project started in 1953-54, and was completed in 1963-64. This reservoir is designed to supply water to the Ravishankar Sagar Project complex, thereby increasing its irrigation potential. Water will also be provided to additional culturable areas in the command of the existing Mahanadi Tandula canal system. The Sondur reservoir is constructed across the Sondur river, a tributary of the Mahanadi. Located near Gram Machka, Nagri block, Dhamtari district of Chhattisgarh state, the dam was constructed in 1988. A major portion of the catchment lies in the Dhamtari district of Chhattisgarh and the Koraput district of Odisha state. The Minimata Hasdeo Bango is a multipurpose storage reservoir on the Hasdeo river, a tributary of the Mahanadi, 70 km from Korba, in Korba District, Chhattisgarh. Tandula is an important project of Chhattisgarh state. The dam is located in Balod tehsil of Durg district, about 5 km from Balod city. The Gondali reservoir was created on the Jujhara nala in 1957. After construction of the Bhilai Steel Plant in 1956, water is being supplied to this plant from the Gondali reservoir, and supply for irrigation has been stopped.

constructed on the Mahanadi and its tributaries upstream of the Hirakud reservoir in the past 50 years. Twenty eight tanks constructed in 4 sub-basins in Chhattisgarh alone, as of 2009, are intercepting flows from a 16,844.94 sq km catchment area, out of a total 83,400.00 sq km catchment area of the Hirakud reservoir (GoO, 2009).

A number of water guzzling industries have now signed MoUs with the Chhattisgarh state government, and have been allocated more than 1,035 MCM of water.[6]

Land Use Changes in the Upper Catchment Area

In Chhattisgarh, 8,49,154.89 hectares of land covering 3771 villages was treated under the Drought Prone Areas Programme (DPAP) and Employment Assurance Scheme (EAS) watershed development programmes, while another 175 watersheds covering an area of 18.5 million hectares area were treated under the National Watershed Development Programme for Rainfed Areas (NWDPRA) after 1990 (Sengar et al, 2008).

About 28% of the catchment area of the Hirakud dam is forested. According to a study by the Planning Commission of India[7], there has been a significant reduction in the number of blocks with more than 60% forest cover in Chhattisgarh, from 1971 to 1991. Dadhwal et al[8] calculated the loss in forest cover area in the Mahanadi basin (with an outlet at Munduli, and delta head in the downstream of Hirakud) in a span of 30 years from 1971 to 1991. They found that it was 5.71% of the total area of the basin, and was accompanied by a reduction in barren land (0.64%), an increase in the area devoted to agriculture (5.55%), surface water bodies (0.47%), built up land (0.22%), river bed (0.11%). Based on a modelling of stream flow, the study concluded that the decrease in forest cover by 5.71% in the Mahanadi river basin had caused the river flow to increase by 4.53% (24.44 mm) at Munduli. Based on seasonal variations, it also concluded that the impact of land cover changes was most pronounced during low flows, and was comparatively smaller during high flows.

The increase in area under watershed treatments and water harvesting structures, and the reduction in forest area over the last 50 years have thus changed the catchment characteristics considerably, which has significantly affected inflow quantity, seasonality, as well as silt yield in the reservoir[9]. This in turn has affected the water availability in and the allocation from the reservoir, which influences the competition, contestations and conflicts. Also, there are outstanding issues between Chhattisgarh and Odisha which, in the absence of any inter-state agreement on water sharing and use between the two states, have not been properly dealt with so far in spite of their significant impact on Hirakud.

Climate Change Implications

The Mahanadi river system falls in a tropical region which is going to see more floods, a decrease in the average runoff, and frequent droughts in the future due to climate change (Intergovernmental Panel on Climate Change, 2007). The water availability in the region will be under stress.

According to the preliminary consolidation report on climate change by the Central

[6] Based on a list of industries with MoUs made by Raghuvir Pradhan, Coordinator, Ekta Parishad, Raigarh, Chhattisgarh

[7] In 1971, there were about 38 blocks in which the forest cover was greater than 61 %, whereas in 1991, there were only 6 blocks in this category. In 1971, there were about 6 districts in which the forest cover was greater than 82.08 %, whereas in 1991 the highest class value was 61.01 percent, and the block with the highest forest cover had about 73.19 % of forested area. http://planningcommission.nic.in/reports/sereport/ser/water_policy/5_ch3.pdf

[8] Dadhwal et al, 2010. A detailed land cover mapping of the basin based on remote sensing for the years 1972, 1985 and 2003

[9] There are also specific problems of land degradation due to open cast mining operations and use of good productive land for brick kilns.

Water Commission (CWC), the Mahanadi river basin is experiencing an increase in mean annual temperature of 0.40 to 0.60°C every 100 years (CWC, 2008). Seasonal analysis shows an increase in rainfall in the post-monsoon period. This basin is experiencing the maximum decrease in the number of rainy days in India. The decrease in annual rainy days in the basin for the last 100 years is 4.70%. There is a 10.53% increase in post-monsoon rainy days every 100 years. On the other hand there is an increase of 16.60 mm in heaviest rainfall spell of the year in the last 100 years (CWC, 2008).

An analysis of the trends in the runoff of the upper catchment gauged at Hirakud and the entire catchment at Naraj showed a steady decrease in the river flows at both these locations during the 55 years from 1926 to 1980 (Rao, 1995).[10] In a modelling study, Raje and Mujumdar, however, predicted an increase in the number of wet days, and also an increase in wet day precipitation amounts (Raje and Mujumdar, 2009). [11] Similarly, Gosain has predicted that the Mahanadi will have the highest increase in precipitation, water yield and evapotranspiration among 12 Indian rivers, along with a forecast of a deteriorating flood situation (Gosain et al, 2006). Muzumdar and Ghosh, however, have indicated a reduction in the occurrence of extreme high flow events in the future, which may be due to the effect of a high degree of surface warming (Mujumdar and Ghosh, 2008). According to a study commissioned by the World Bank, the basin will be wetter and warmer. There will be less warming during the monsoon season, and more rain during the winter/pre-monsoon season. The increase in minimum temperature will be more than that in the maximum temperature. The surface water availability will be more under climate change conditions, with more floods expected to occur due to increased rainfall in the region (Satya Priya, 2006).

The hydrologic impact of climate change is likely to result in decreasing performance and annual hydropower generation for the Hirakud reservoir. Mean monthly storages are likely to decrease in future scenarios. In many scenarios for 2075-95, the reservoir is unable to get filled by the end of the monsoon in October (Raje and Mujumdar, 2010).

Based on a modelling study which considered seasonal changes in runoff, future water demand by different sectors, and projected water availability, Asokan and Dutta have emphasised the need for redefining water management policies, by incorporating the hydrological response of the basin to long-term climate change, in order to help in developing appropriate flood and drought mitigation measures at the basin level (Asokan and Dutta, 2008).[12] However, there seems to be a lack of recognition of climate change implications by the decision makers for the dam, and consequently, a lack of strategies to adapt to climate change.

Inflow quality

According to a water quality study by the Central Pollution Control Board (CPCB), the Mahanadi is comparatively less polluted compared to other important rivers in the country (CPCB, 2005). However, certain stretches have a comparatively higher degree of pollution. Korba has been identified as a critically polluted area in the basin. The industrial as well as domestic wastewater is being discharged directly into the Hasdeo and Ahiran rivers, as well as the Dengur nala. The major source of pollution in

[10]This is statistically significant at the 1 % level. The time series of moisture indices for the catchment shows a clearly declining trend during the period 1901-80. The climate warming that occurred over the basin (which increased at a highly insignificant rate of 1.1 C° per century) is not being offset by an increase in precipitation. In fact, a slight decrease in precipitation was observed. As a result, there is a gradual decrease of river flows in the upper catchment as well as in the entire basin during the period 1926-1980.

[11]The model is applied for downscaling monsoon (June-September) daily precipitation at 8 sites in the Mahanadi basin in Odisha, India, using the MIROC 3.2 medium-resolution GCM. The predicted distribution at all sites shows an increase in the number of wet days, and also an increase in wet day precipitation amounts.

[12]The study showed the highest increase in peak runoff (38%) in the Mahanadi river outlet during September, for the period 2075-2100, and the maximum decrease in average runoff (32.5%) in April, for the period 2050-2075. The Mahanadi river basin is expected to experience progressively increasing intensities of flood in September, and drought in April, over the considered years.

the basin is thermal power plants, the Bharat Aluminium Company, the captive power plant of Bharat Aluminium Co. Ltd. (BALCO), IBP (the explosive unit), and coal mining, most of which are located on the banks of the Mahanadi river or its tributaries and distributaries.

The water quality has also been affected by run-off loaded with fertilisers, insecticides, and pesticides from farming activities, besides the discharges from industries and human settlements. Along with the impacts on fish diversity and production, the polluted inflow is also threatening to affect the water supply for agriculture[13] and drinking.

Silt Flow into the Reservoir

The silt flow into the Hirakud reservoir is high as there has been considerable deforestation in the upper catchment area. The former chief engineer of Odisha, B Das, had flagged siltation as a major, emerging crisis. He said that the reservoir has already lost water storage capacity of around 20 per cent due to siltation. The assistant director of the State Dam Safety Organisation, A. K. Das, said, “The maximum emphasis should now be placed on the management of the catchment area. Proper land use would help restrict siltation.”

However, it seems to be an uphill task for the state government to put a holistic management system in place for the upper catchment, since nearly 75,000 sq km of the 83,400 sq km catchment area falls in other states. Watershed treatment of upstream watersheds is one of the long term measures against soil erosion and flood. Soil conservation measures in the upper catchment of Hirakud have implemented extensively. This has been a continuous process since the sixties and is still in progress, but it seems to have been ineffective in controlling the silt load at Hirakud.

The silt deposit in the Hirakud reservoir is increasing year after year. The Odisha Space Applications Centre (ORSAC)[14] states that if this situation continues unchecked, by 2065 AD, 460.3 million acre feet of silt will be deposited in the reservoir, which is about 70.2 % of the dead storage capacity.

Fly Ash and Heavy Metal Contamination

Fly ash and its slurry are major components of the effluents entering the reservoir directly. Almost all industrial units around the Hirakud reservoir have captive and independent thermal power plants. More than 5000 MW of thermal power is being generated in the area around the reservoir.

All thermal establishments are coal-based and procure coal from the Ib valley coal field of Mahanadi Coalfields Ltd. The earthen material percentage in the coal used is more than 40%. As a result, a large amount of fly ash is formed due to the coal burnt in the thermal power plant. To manage the fly ash, there are provisions to make slurry by mixing it with water and transferring it to ash ponds. Incidents of breakage of the wall of ash pond and slurry pipeline are occurring in this region. Most thermal power units also dump their dry fly ash in open fields. Wind blows the ash away from the dumping sites to villages, agricultural fields, houses, water bodies, and trees in the vicinity.

[13] During September 2011, the flood in the Mahanadi destroyed standing paddy crops, caused skin burns and allergic skin infections for many farmers. Farmers alleged that the rotten paddy fields were emitting a bad smell which was due to the release of effluents directly into the river by one industry during the flood. A number of news agencies and print media reported similar incidents. Based on these experiences of farmers which were reported to the National Human Rights Commission (NHRC), an enquiry by the Odisha State Pollution Control Board on the matter is in progress.

[14] Quoted in the web article "Environmental Degradation in Odisha", http://ww.webindia123.com/orissa/land/environment.htm

The Ib thermal plant of Odisha Power Generation Corporation (OPGC), and the independent thermal power plants of Vedanta Alumina and Bhushan steel, are all in close proximity of the reservoir. Moreover, there are also a number of fly ash deposits in the Hirakud catchment in Chhattisgarh, which also contribute to fly ash contamination in and around the reservoir.

The ash pond of the Ib thermal plant is right on the bank of reservoir. This ash pond is located on the reservoir land taken on lease by OPGC for the purpose of ash dumping. The slurry pipeline of this ash pond passes through the reservoir water. Recently, the pipeline leaked and discharged fly ash slurry directly into the reservoir.

The dumping of fly ash in the ash pond is having an adverse impact on underground, surface and local water sources (Dharmadikary and Dixit, 2011). Fly ash also contains heavy metals such as Iron, Manganese, Copper, Zinc, Chromium, Nickel Lead and Cadmium which are serious contaminants and capable of causing health hazards. The high level of heavy metals in soil contaminated with fly ash causes even higher accumulation of heavy metals in plants (Singh et al, 2010).

Effluent Flow

A variety of industries have been established in the region owing to the vast mineral and human resources of the basin and power generation infrastructure. The important industrial regions in the basin in Chhattisgarh are Bhilai, Durg, Raipur, Rajnandgaon, Korba, Urla and Bilaspur, while the important urban centres are Raipur, Bhilainagar, Bilaspur, Durg, etc. These urban and industrial centres utilise its water resources intensively, and release wastewater. The water quality has deteriorated in the Seonath, Arpa and Ib tributaries by the wastewater generated from urban centres as well as paper mill effluents.

The iron and steel industry at Bhilai, cement industries at Durg and Raipur, textile industry of Rajnandagaon, and aluminium and thermal power plants at Korba are the major polluting industries in Chhattisgarh, which drain their effluents in the river basin. All these major units are located on the banks of the Seonath, Kharoon and Hasdeo. The medium scale industries include chemical plants and distilleries of Durg, cement industries of Raipur, iron and steel plants of Urla, paper industries of Bilaspur and many other agro-based industries. All these industries discharge their wastewater either directly or indirectly into the Mahanadi river and its tributaries, using the river bodies as the sink.

The Central Pollution Control Board said the following about the water quality of the Mahanadi river: “What is more critical is the runoff contamination. The runoff in this region is likely to be contaminated with fluoride since the smelter in this region would annually consume about 80,000 tonnes of fluoride-bearing materials. Considering one percent spillage and related loss, about 800 tonnes of these materials may be washed into the reservoir.” (OSPCB, 2011) The Odisha Pollution Control Board (OPCB) also raised an alarm that if the Hirakud reservoir is contaminated with fluoride, there might be an epidemic of fluorosis in the region (OSPCB, 2011).

Mining activities around the reservoir are being carried out right from the time it was formed. The Ib valley coalfield of Mahanadi Coalfield Limited (MCL) is in the peripheral region of the reservoir. There are open cast mines at Brajarajnagar and in the Belpahar region around the reservoir. Water for mining activities and coal washeries is lifted directly from the reservoir. The overburden which is removed directly comes into the reservoir, resulting in an increase in the sedimentation rate within the reservoir. Effluents from mining activities are mainly deposited into the Lahiri nala in Lakhanpur block of Jharsuguda district, which directly flows into the reservoir.

According to the Odisha State Pollution Control Board, the present rate of solid waste generation due to industrial activities in Sambalpur and Jharsuguda region is 4.58 Million Tons Per Annum (MTPA), and is expected to increase almost 13 times to 58 MTPA by 2031 which would require 13,000 ha of land in the peripheral region of the reservoir for its disposal (OSPCB, 2011).

6

Chapter 6
The Hirakud Reservoir: Changing Conditions, Allocations and Incomplete Rehabilitation

This chapter deals with the issues related to water conflict in the reservoir. The allocation of water to industries, and use of water by industries from the reservoir, led to a conflict between industry and agriculture in the region. Changes in reservoir operations could cause more water conflicts in the region. The periodic lack of water availability in lean periods, and sedimentation at the mouth of the Sason canal, leads to major agitations by farmers. The change in storage space, availability and quality of water have a direct bearing on the ongoing and emerging water conflicts in the region.

This chapter also deals with fishery-related issues and the hurdles faced by those whose livelihoods depend on fisheries. It also provides a brief explanation about the reservoir operation and rule curves. Reservoir operations management is crucial for flood control. At the same time, filling up the reservoir up to the full reservoir level by the end of the monsoon is necessary for power production and irrigation. The mismanagement of reservoir operations has always resulted in conflicts. The allocation of water to different sectors such as irrigation, power generation, drinking and industries are also discussed in this section. The chapter shows how the allocation regime around the reservoir was altered after 1990. Finally, it discusses issues related to displacement and rehabilitation of the people affected by dam construction.

The Hirakud reservoir contributes about 50% of the total water storage potential in the state (GoO, 2007). It has a gross storage of 8.13 billion cubic metres (BCM) (6.6 million acre-feet (MAF)), of which the live storage is 5.82 BCM (4.72 MAF) (GoO, 2007). The original live storage capacity of the reservoir was 5,818 million cubic metres (MCM), which in 1988 was revised to 5,375 MCM. In 2007, it was probably around 4,647 MCM (GoO, 2007). This 20% or so reduction in the storage capacity is due to the accumulation of sediments in the reservoir. The average annual inflow of water to the reservoir, fed by the two rivers, the Mahanadi and the Ib, is 37 MCM. Three canals originate from the reservoir: the Bargarh canal, Sason canal and the Sambalpur distributary.

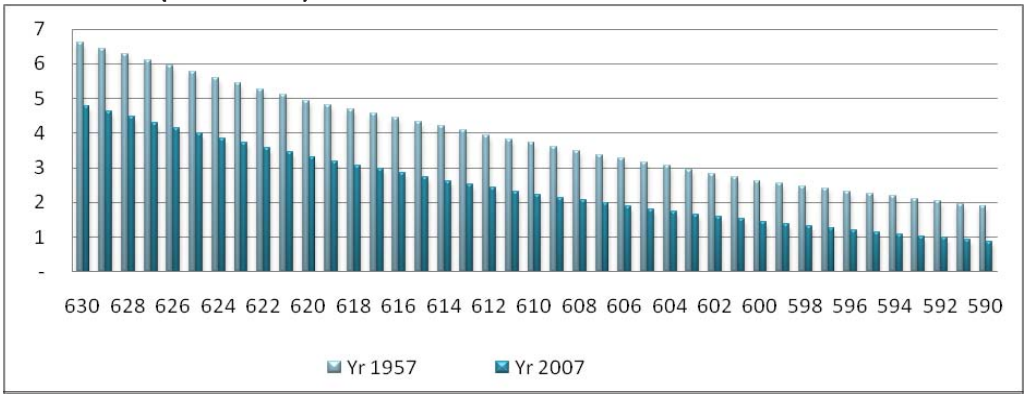
Storage

The Hirakud reservoir covers 743 sq km at full capacity. This reservoir is the largest artificial lake in Asia, with a 640 km long shoreline. At reservoir level (RL) 625 ft, it submerges an area of 54,000 ha.

Statistics show that the average maximum reservoir level is maintained at around 627 feet. In 1966, 1974, 1979 and 2000, the maximum reservoir level was less than 620

feet. It is difficult to assess the storage capacity of the reservoir, taking into consideration the filling of the reservoir in any one year.

Fig. 6.1: Change in the reservoir capacity (MAF) between 1957 and 2007 at different RL (GoO, 2009)



Siltation and Silt Distribution

Siltation and sediment deposition is an important aspect causing reduction in the storage capacity of the reservoir. A remote sensing survey conducted by the Central Water Commission (CWC) in 1995, and another by the dam authorities in 1996-97 over water storage capacity, reveals that the total water storage capacity of the dam has come down by 27.25 % due to siltation (GoO, 2009). There has been a 17 % reduction in the storage capacity of the dam (GoO, 2009). Multiple surveys have been conducted: a survey in 1957, a three phase survey in 1986, another survey in 1988 on the recommendation of the rule curve committee, a remote sensing survey in 1995, a report in the year 2000, etc. The expert committee's report also assessed the storage capacity of the reservoir to find out whether irrigation will be affected by diverting water to industries (GoO, 2007).

According to the Hirakud Dam Project Report 1947[1], the annual silt carried by the stream was not expected to exceed 75 acre-foot (AF) per 100 sq miles of catchment. The silt yield of the Mahanadi catchment above the Hirakud dam site (32,200 sq miles) was therefore estimated to be below 24,150 AF of silt load. This analysis assumed that 25% of the catchment is covered by a reserve forest and *Zamindari* forest. In the report, the proposed sedimentation into the reservoir was compared with that of the Aswan Dam on the Nile in Egypt, as well as that of the Grand Coulee Dam on the Columbia river in USA.

The live storage capacity of the reservoir is 8% of the annual runoff at the dam site. Based on this, Dr. A. N. Khosla suggested that the silt deposition in the reservoir should not exceed 8% of the annual silt yield. The dead storage capacity was kept at 1.20 MAF for trapping the silt over 600 years.

An arrangement of deep sluice gates with a capacity to release 700,000 cusecs of flood water was also provided to remove almost the entire suspended silt and a large amount of coarse silt as well. Assuming this flushing of silt, it was expected that the average silt deposition in the reservoir would be in the range of 8,000- 12,000 AF per year. Thus, it was considered that the live storage will not be affected for 150 years, and with conservative calculations, for 100 years.

[1] According to the silt charge analysis of the Mahanadi river by Dr A. N. Khosla

However, after dam commissioning, Dr. A. N. Khosla observed that the silt yield of the Mahanadi river at Hirakud in the year 1947 (June to December) was 33,235 AF at a runoff of 39.18 MAF from the 32,000 sq miles catchment. This was considerably higher than the annual silt yield assumed in the project report (24,000 AF per year). The observed silt yield was compared with the 50 MAF annual average runoff of the Mahanadi river at Hirakud, which showed that the average silt yield would be 42,500 AF annually. Considering that 50% of silt will be deposited in the reservoir (the remainder 50% would get flushed out), a dead storage of 2.125 MAF would be required for 100 years. For preventing reduction in live storage due to siltation for 100 years, they recommended[2] raising the dead storage from RL 580 feet (capacity 1.57 MAF) to RL 590 feet, to provide a capacity of 2.24 MAF for dead storage.

There was a thorough investigation of silt yield and load at the dam site in the Mahanadi river during the years 1947 to 1951. It was observed that the silt load in the reservoir would be 91.82 AF per 100 sq miles per year. Out of the total silt load, 57% would be trapped in the reservoir. The study indicated that nearly 75% of silt will be fine silt, of which 90% will be washed out by flood water, and only 10% will be deposited in the reservoir. This analysis indicated that the live storage would start getting affected after 132 years (100 years, according to the Project Report of 1953). However, it was observed that the live storage started to be affected by siltation right after water was first impounded in the reservoir in 1957 (Irrigation and Power Department (IPD), 1986).

The third sedimentation study was conducted in 1986, which showed that 74.4% of total silt inflow into the reservoir is deposited inside the reservoir (IPD, 1986). It estimated that the silt inflow into the reservoir at 8.33 ha m/100 sq km/year (174.93 AF per 100 sq miles/year), which is almost twice the observed value during 1947-51 and about two and half times the value estimated in the report of 1947. Location wise, 62% of sediment was deposited in the upper 38% of the reservoir storage depth (between RL 580 ft and 630 ft) and 49% of sediment deposited was between RL 590 ft and 630 ft within live storage.

Table 6.1: Reservoir capacity loss between 1957 - 1986[3]

	Original capacity in MCM	New capacity in MCM	Silt deposited MCM	Loss % per year
Dead storage Below RL 179.83 m (590')	2262	1500.924	753.076	1.148
Live storage RL 192.02 m to 179.83 m (630' to 590')	5843	5105.78	737.22	0.435
Gross storage RL 192.02 m (630' and below)	8105	6614.7	1490.3	0.634

The reduction in live storage, dead storage and gross storage of the reservoir up to 1985, was 13%, 33% and 18% respectively. At the rate of 6.2 Ha M/year per 100 sq km, sedimentation in 100 years (2056; 1st impounding in the reservoir was in 1957) was predicted to be 5138.57 MCM, which is 63.4% of the total storage.

The first satellite remote sensing study of sedimentation was conducted in 1988. The gross storage capacity of the reservoir was estimated to be 6151.30 MCM, with a capacity loss of 1953.70 MCM (24.10%) in 30 years (1957-1988).

[2] This recommendation was made in the Report of the Advisory Committee on the Hirakud Dam Project, 1948, according to which: "The silt observations of 1947 having given higher figures of silt load than assumed in the project report, the silt reserve as now recommended by the consulting Engineer be adopted and the dead storage level be fixed at 590 .00 feet accordingly."

[3] Third Cycle Sedimentation Study Report of the Hirakud Reservoir

The second remote sensing sedimentation study of the reservoir was conducted in 1995 by the CWC. This study was referred to in the Jayaseelan Committee report (GoO, 2007). The Gross Storage and Live Storage of the reservoir were found to have reduced to 6,145 MCM (4.98 MAF) and 4,934 MCM (4.00 MAF) respectively. The average loss of gross, live and dead storages was computed to be 0.64%, 0.41% and 1.22% per annum respectively. At this rate of sedimentation, the live storage capacity of the reservoir in 2007, when the committee was in action, was estimated to be 4,647 MCM (3.77 MAF). The loss in live storage in 50 years was 20.12%. The rate of loss of storage showed a reduction with time compared to the initial years of observation.

The remote sensing sedimentation study of the reservoir in 2007 showed that the live storage of the reservoir was reduced only by 11.79% (with a capacity loss of 688.99 MCM), dead storage by 65.85% (with a capacity loss of 688.99 MCM) and gross storage by 26.83% (with a capacity loss of 2174.77 MCM).

Table 6.2: Reservoir capacity loss between 1957 - 2005-06 (NRSA,2007)

	Original provision in MCM	SRS, 2005-06 in MCM	Silt deposited MCM	Loss % per year
Dead Storage: Capacity at Minimum Draw Down Level (MDLL)	2262.11	776.32	1,485.79	1.31
Gross Storage: Capacity at FRL (192.02 M)	8104.99	5930.22	2,174.77	0.54
Annual rate of reservoir capacity loss	2.5 ha-m/100 sq km/year	5.32 ha-m/100 sq km /year		

The sedimentation surveys through satellite remote sensing were unable to analyse the dead storage sedimentation (Sedimentation Report, 1986). This method was also unable to show the sediment distribution within the reservoir. Parameters such as silt trap efficiency and amount of suspended silt could also not be analysed through the remote sensing technique.

Siltation is emerging as a major crisis. The reservoir has already lost water storage capacity of around 20% due to siltation. The observed rate of siltation of the Hirakud dam is higher than the rate adopted when it was designed. Due to siltation in the leading/approach channel at intake points, there is the additional difficulty in drawing the design discharge into the canals when the reservoir level is below 595 ft.

Water Quality in the Reservoir

Based on the pollution potential, the Ministry of Environment and Forests, Government of India has categorised industries as red, orange and green. 65% of industries in Odisha are classified as red or potentially most polluting industries, most of them engaged in primary manufacturing; 20% are classified as orange, and 15 % as green. The more polluting among the industries classified as red are again classified as grossly polluting, based on their water polluting load (i.e. if it exceeds a Biochemical Oxygen Demand (BOD) count of 100 kg/day), or if their effluent contains hazardous chemicals. Odisha has 18 such industries. There are 15 large industries - aluminium and thermal power plants - at Hirakud, which discharge effluents directly into the

Mahanadi. The total industrial effluent released into the Mahanadi at Sambalpur is 736 kilolitres per day (KLD). Several medium and small industries on the Mahanadi basin discharge 100,000 m^3 of waste water every day.

According to the Comprehensive Environment Pollution Index, out of 88 polluted industrial areas, the Ib Valley and Jharsuguda are among the critically polluted area (OSPCB, 2010a). National Environmental Engineering Research Institute (NEERI) has highlighted the toxic effluents generated by the industries in the Rengali and Jharsuguda areas (OSPCB, 2010b). More than 3000 MTP of fly ash from the industries directly flows into the water sources, which ultimately join the Hirakud reservoir.

The sewage water of the Vedanta project bears the maximum level of fluoride, i.e. 6.5 mg per litre. The highly poisonous water of the Bheden and Kharkhari is not suitable for fish life any more, thus depriving many people of a means of livelihood. The polluted water from these streams directly flows into the reservoir and degrades the quality of water. The integrated aluminium plant (smelter plant and captive power plant) of one of the biggest producers of primary aluminium in Asia, Hindustan Aluminum Company (HINDALCO) is located at the Mahanadi head at Hirakud, 5 km from the dam. HINDALCO's smelter plant in Hirakud is ISO 14001 certified, for exemplary work in practicing environmental management. It has installed most of the required pollution control systems. Yet, in November 2007, the Sambalpur regional office of the Orissa State Pollution Control Board (OSPCB) slapped a case against HINDALCO, for discharging effluent from its smelter plant site that contained eight times more fluoride than permissible limits, not into its designated outlet but into the Kharjor nullah, a major natural creek that runs adjacent to the plant and drains into the Mahanadi River, and which is used by the local population for domestic purposes. As is being seen once too often, pollution from industries occurs not so much because the mandatory pollution control equipment is not installed, but because of lack of good practices and vigilance. Pollution of the river is still on the rise. A very high concentration of iron, sponge iron, and coal based thermal power stations has made the water quality worse.

In 2010, the State Pollution Control Board studied the environmental impact of heavy industries on the Sambalpur and Jharsuguda region, and assessed the impact of upcoming industries on the region. According to the report, the current withdrawal of water for industrial purpose will increase 20 times to 2143 million litres per day. There will be a sharp increase in effluents in the reservoir due to heavy water intake from the reservoir. At present, industrial effluents are directly discharged into different *nallas* and rivers such as the Bheden and Ib, which ultimately drain into the reservoir. Fluoride contamination of the reservoir is increasing sharply in the recent period. According to the media reports and local people six Grampanchayats in peripheral region of reservoir show loss of cattle and livestock due to diseases of the foot and mouth, owing to the fluoride contamination. Recently, farmers from Mahamadpur village of Sambalpur district, which is situated near the left dyke of the reservoir, faced severe crop losses due to fluoride emission from the HINDALCO smelter at Hirakud. This is for the third time that villagers around this smelter plant are facing crop losses due to fluoride emission. Fluoride is a major pollutant originating from aluminium smelting, which pollutes the air, water and soil. An aluminium smelter has been operating at Hirakud in western Odisha since 1958.

Fishing and Livelihood

Fishermen dependent on the Hirakud dam reservoir for their livelihood are now very worried. When they stick to the rules and regulations of fishery policy in the reservoir, it is outsiders, particularly Bangladeshis and the mafia, who ignore these rules. As a result, the fish production capacity of the reservoir is reducing every year, according to the members of the local fishermen's cooperative society.

Fish production from the reservoir was one of the priorities in the original project report. The fish production began right when water was first impounded in the reservoir. The presence of direct sunlight and more transparent water caused an algal boom with a high rate of primary production in the reservoir (Sugunan, 1995). The primary production is mainly dependent on the phytoplankton present in the water body. There are 39 phytoplankton species in the Hirakud reservoir (Dash et al., 1983). Before its construction, there were 183 species of fish, out of which 24 varieties were commercially important (Job et al., 1955). After the formation of the reservoir, there were changes in the fish population around the Mahanadi river, and the number of fish varieties was reduced to 62 species[4]. The construction of the dam led to the destruction of river fisheries. According to the report of Central Inland Fishery Research Institute (CIFRI), Barrakpore, submitted to the Minister of State in charge of the Department of Agricultural Research and Education (DARE), Government of India, in 1992, there were 40 fish species of commercial importance in the reservoir (Sugunan, 1995). The Hirakud reservoir is home to the Mahseer fish, which is an endangered species in India. This fish is well adapted to the reservoir water and environment (Rashid and Tripathy, 2005).

Local fishermen of the Hirakud reservoir urge the Odisha Government to save the fish in the reservoir. In this regard, the fishermen had submitted a memorandum to the Revenue Divisional Commissioner (RDC) of the Northern Division, citing mafia *raj* inside the reservoir and the dwindling numbers of fish species. They expressed concern over the callousness of the three district administrations of Sambalpur, Bargarh and Jharsuguda which have jurisdiction over the sprawling reservoir. Earlier in 2001, when T. Ramchandru was the Revenue Division Commissioner (RDC) here, he had called a high-level meeting of the local civil administration and forest and fishery departments of the three districts to chalk out an action plan for increasing the fish production capacity of the reservoir along the lines of that in Andhra Pradesh. In their memorandum, they had appealed to the RDC to do something concrete so that the interests of nearly 5,000 families solely dependent upon the reservoir for fishing could be safeguarded.

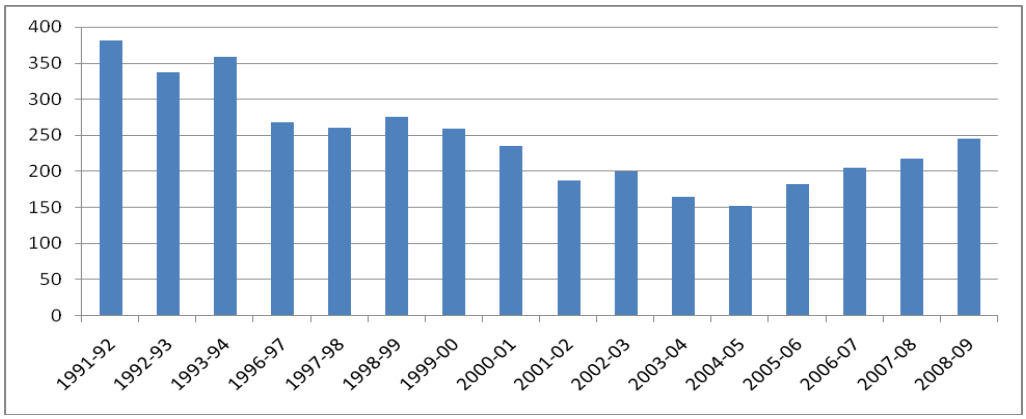
With the inflow of industrial effluents directly into the reservoir water, the productive and consumptive capacity of phytoplankton has reduced. Researchers have noted that the consumption and productivity would be reduced to zero under more stressful conditions, due to toxic effluents emitted by Orient paper mill (Patra et al., 1991). The pollution of the water has resulted in the extinction of 140 varieties of fish species out of 183 in the last 50 years.

[4] as quoted in Rashid and Tripathy, 2005

Table 6.3: Year wise fish production from Hirakud reservoir[5]

#	Year	Production in tonnes
1.	1961-62	51.9
2.	1962-63	32.4
3.	1963-64	14.4
4.	1964-65	15.4
5.	1965-66	12.4
6.	1985-86	332.8
7.	1986-87	483.0
8.	1987-88	192.1
9.	1988-89	263.5
10.	1989-90	337.4
11.	1990-91	489.5
12.	2006-07	151.54

Fig 6.2: Fishery production from 1991-92 to 2007-08 in metric tons (MT)



The production has also come down from 843 MT during 1980-81, to 332.80 MT in 1990-91, to 151.54 MT in 2004-05. More than 20,000 fishworker families dependent on the Hirakud reservoir are in danger of losing their livelihood completely. According to government officers, the reduction in fish catch is due to fishing in the ban period, and the use of zero mesh size nets. There are cases of illegal fishing by local mafias. The fish production has also been reduced due to industrial effluents from thermal power plants, alumina smelter, ash ponds, coal mines, sponge iron plants and coal washeries.

The Joint Action Committee, Jharsuguda[6] had organized a huge gathering before the Tehsil Office of Lakhanpur on 1st December, 2010 to submit their demands to the Chief Minister of Odisha through the concerned Tehsildar, and protest against the unmindful state government and its inaction which was leading to the death of the Hirakud reservoir. Their key demands included protection of the interests of fishermen communities by controlling pollution in the reservoir, and stringent action against Bhushan Power and Steel Company which is withdrawing water from Bheden without due permission, and polluting the river by releasing toxic effluents.

In the initial period of reservoir formation, there was an absence of commercial fishery. The fishery rights were transferred to the fishery department of the state government in 1960. Most of the displaced families settled around the reservoir waterspread. As there were no other livelihood options available to the displaced people, they started fishing inside the reservoir to earn a livelihood. They were trained

[5] Sugunan, 1995, and media reports

[6] This committee is a non-registered organisation of Jharsuguda district working towards the protection of life and livelihood of the masses in the district. Activists, fishermen, farmers, farmer leaders and political party representatives participated in this campaign. The participants expressed their concerns and views about the Hirakud reservoir water crisis. They asserted that the state government was destroying the water, land and forest around the reservoir in the name of industrialisation.

in other fishing techniques by Bangladeshi settlers. The fisheries department divided the reservoir into six sectors for fishing purposes. Of these sectors, fishing was banned in one sector near the dam wall due to security concerns. However, experimental fishery was allowed (Sugunan, 1995). The five sectors were distributed to fishermen cooperative societies on a lease basis.

Table 6.4: Fishing cooperative societies in Hirakud with their areas of fishing lease

#	Name of society	Area of fishing lease in sq km
1.	Tamdei	67.34
2.	Lachhipali	41.44
3.	Thebra	111.37
4.	Mahamadpur	116.55
5.	Ib	98.42

The fishing lease was Rs. 100/sq km/year. The fishing leases are given by the fisheries department to the cooperative societies. There are nearly 5000 fishermen engaged in fishing who are members of the fishing cooperatives. According to the new fishing policy of the state government of 2005, the fish leases will be charged on a hectare basis. There was an announcement of a new fishing lease rate of Rs. 250 per hectare. This step by the fishery department increased the fishing lease cost by 25 times. The fishermen agitated against this move of the state government. The fisheries department is now ready to reduce the fishing lease up to Rs. 160 per hectare, which is still not acceptable for the fishermen.

According to the leader of the fishermen, Gopinath Majhi, there is no other livelihood option for fishing communities around the reservoir. The sudden increase in the fishing lease is exploitative. The increase in illegal fishing and the use of dragging nets is also reducing the fish production in the reservoir. The pollution of reservoir water due to the direct discharge of industrial effluents is reducing fish production as well.

Allocation of Reservoir Water

The dam had four main objectives – flood management, hydropower production, irrigation and navigation. Hirakud's performance regarding flood control has already been discussed earlier. In this section, its performance in terms of the allocation of reservoir water between the different objectives is discussed, and its temporal trend analysed.

Water Allocation Before 1990

Water utilisation for the different purposes started with the first impoundment of water in the reservoir in 1957. Irrigation water was delivered through direct and delta irrigation (after power generation) systems. Hydropower generation started at two sites at Burla and Chiplima below the dam site. Irrigation areas started to expand after 1961, through high yield varieties (HYV) experiments in the command region.

Until 1990, water utilisation from the dam was mainly for hydropower generation and irrigation. Industrial water use was nominal during this period. Hydropower generation

was prioritised. However, flood control was the major purpose of the project. The main reason for the appointment of the rule curve committee in 1988 was the reduction in power generation from the dam. For the generation of electricity, the water level in the dam is required to be at a higher level, but at the same time, water levels during the monsoon period should be low and as near to the dead storage level as possible for flood control, which was the main priority of reservoir operations. Most post-Hirakud floods have been attributed to the mismanagement of reservoir operations.

Water intake from the reservoir through lift for peripheral area irrigation was strictly prohibited as it would affect hydropower generation from the dam. Farmers who tried to take water directly from the reservoir for saving their crops during dry spells had their pumps seized and criminal cases filed against them by the dam authorities. Late Sri. Prasanna Kumar Panda, who was then the Member of Legislative Assembly (MLA) from Brajarajnagar, raised a question in the assembly about the lack of irrigation facilities in the peripheral region of the reservoir, though there was a provision for lift irrigation in the Hirakud dam project report. The response from the state government was that lift irrigation would affect hydropower generation and consume more electricity, and hence has been done away with.

The water for direct irrigation was mainly provided through gravity flow in the direct irrigation system. This system started to become defunct from 1971 onwards, as a number of villages began to be cut off from irrigation facilities due to a lack of proper infrastructure in tail areas.[7]

In 1952, according to the Hirakud Dam Project Report, there was no allocation of water to industries.[8] However, water was supplied to industries such as Indian Aluminum Company (INDAL), Tata Refractories, Orient Paper Mill, the railways, and for drinking water supply to Sambalpur town. The amount of reservoir water used for purposes other than agricultural was negligible before 1986. According to retired electrical engineer for the Hirakud reservoir, Karunakar Supkar, the industrial water intake from the reservoir was nearly 20 to 23 cusecs.

Water Allocation After 1990

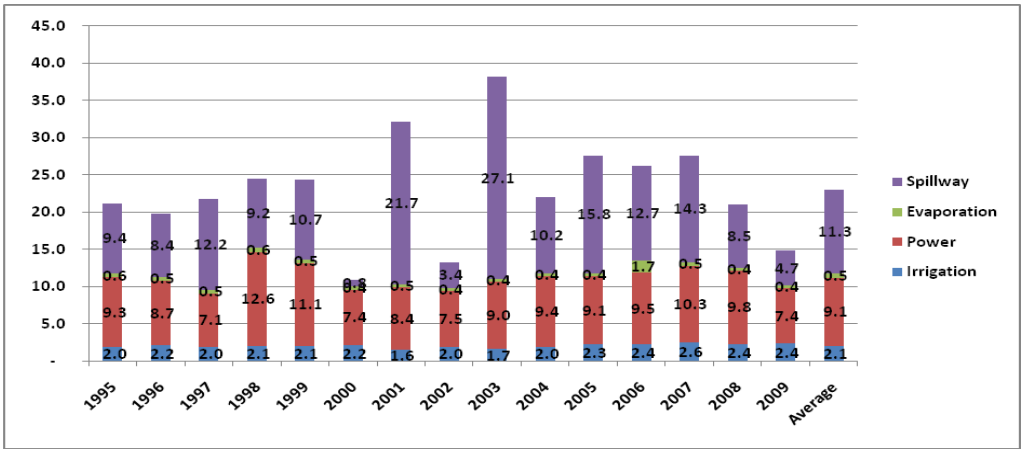
After the Indian economy was opened up in the so called reform era, there were new water policies which set new priorities for water use for different sectors. According to a letter from the Joint Secretary, Government of Odisha to the Engineer in Chief, Irrigation dated 26th November, 1990 (letter no. Irr-III-HKDW-6/90), the industrial water use from the reservoir was 4.60 cusecs which amounts to 0.01 MAF annually. Due to the proposed industrialisation around the reservoir, mainly for thermal power generation, there was a demand of 305.47 cusec water supply for industrial purposes amounting to 0.20 MAF annually. Besides this, the National Thermal Power Corporation (NTPC) had requested about 200 cusecs of water for the installation of a power station to generate about 2000 mega watt (MW), which accounted for about 0.1 MAF of water. Further, this letter stated that 0.350 MAF of water from the reservoir should be reserved for industrial purposes. Other stakeholders were not consulted about this reservation of water for industries. It was estimated that at the end of the monsoon, there would be 4.88 MAF water available in the dam, out of which about 1.1 MAF would be for irrigation and 3.5 MAF for hydropower generation.

[7] WRD, 1999. The irrigation canal survey was not undertaken before the construction of the irrigation system, though the Project Report (1947), Advisory Committee Report (1948), and the Project Report of Hirakud Dam Project (1952) had prescribed a detailed canal survey before laying the canals. The canals were laid according to toposheets rather than actual surveys, leading to the failure of the system, and a wrong assessment of the culturable command area. The irrigation areas in the head region started to increase beyond the prescribed area, and at the same time, the irrigation areas at the tail started to reduce.

[8] GoI, 1953. This project report explained that water allocation from Hirakud reservoir will be for drinking, irrigation, fishery and navigation. There was absence of Industrial water allocation. However there were some industrial units around Hirakud reservoir who were taking water from reservoir for industrial purposes.

The Water Resources Department allocates water to different industries and commercial establishments according to the provisions of the Orissa Irrigation Act, 1959, the Orissa Irrigation Rules, 1961, and amendments from time to time. Currently, water is being provided to industrial units and commercial establishments according to the recommendation of the Technical Committee known as the Water Allocation Committee. So far, water has been allocated to 61 Industries and other organisations through the Water Allocation Committee (WAC).

Fig. 6.3: Hirakud water utilization (MAF) between 1995- 2009



According to the revised[9] storage in the year 2000, the gross storage capacity was 4.78 MAF, with 3.91 MAF live storage and 0.87 MAF dead storage. From the live storage, 1.30 MAF water was allocated for direct irrigation, 0.39 MAF water accounted for evaporation, 0.32 MAF for industries, and 1.87 MAF remained as balance water used for power generation and delta irrigation. However, according to the Water Resources Department data on annual runoff (inflow) into the reservoir and outflows, on an average during 1995-2009, 2.1 MAF (9%) was used for irrigation, 9.1 MAF (40%) for hydropower production, 0.5 MAF was lost through evaporation, and 11.3 (49%) MAF was flowing down over the spillway.

After 1991, the water allocation from the reservoir to industries started to increase, and that for hydropower generation and irrigation began to decline. According to Supkar, to provide water for industrial purposes, the water level in the dam is maintained at 595 ft at the end of the summer, thus compromising hydropower generation from the dam. Because water is diverted from hydropower generation, there are shortages of drinking water in Sonepur and Bolangir towns in the downstream. During 2005-07, the irrigation water shortages in the Sason command region triggered an agriculture vs industry water conflict, which was at its peak during 2007. Competition among stakeholders related to water utilisation from the dam is increasing day by day.

During 1958 to 2009, on an average, 1.231, 0.350, 4.204 and 0.004 MAF of water is being used annually for direct irrigation, industries, generation of electricity and domestic use of urban areas respectively in the non Monsoon (October to May) period. The average non monsoon runoff during November to May) for the period is 1.334 MAF which is less than the non-monsoon consumptive use. The live storage in the dam is 3.77 MASF which too does not cover the needs of hydropower. This is leading to a reduction in hydropower generation from dam and consequently, downstream supplies. The competition between different uses becomes more intense at the end of

[9] A reservoir sedimentation study was conducted in 1995 by CWC using the remote sensing technique. The Gross Storage and Live Storage of the reservoir were found to have reduced to 6,145 MCM (4.98 MAF) and 4,934 MCM (4.00 MAF) respectively. The average loss of gross, live and dead storage was computed to be 0.64%, 0.41% and 1.22% per annum respectively. At this rate of sedimentation, the live storage capacity of the reservoir at present (in 2007) would be 4,647 MCM (3.77 MAF). The loss in live storage in 50 years is 20.12%. The rate of loss of storage reduces with time compared with the initial years of observation. Jayseelan committee report, GoO, 2007, Para 3.2.7

lean period when there is very little water available in the reservoir. The late onset of the monsoon results in a greater rabi demand and adds to the intensity of competition an intensifies water conflicts around the reservoir.

Sectoral Allocations

Power Generation

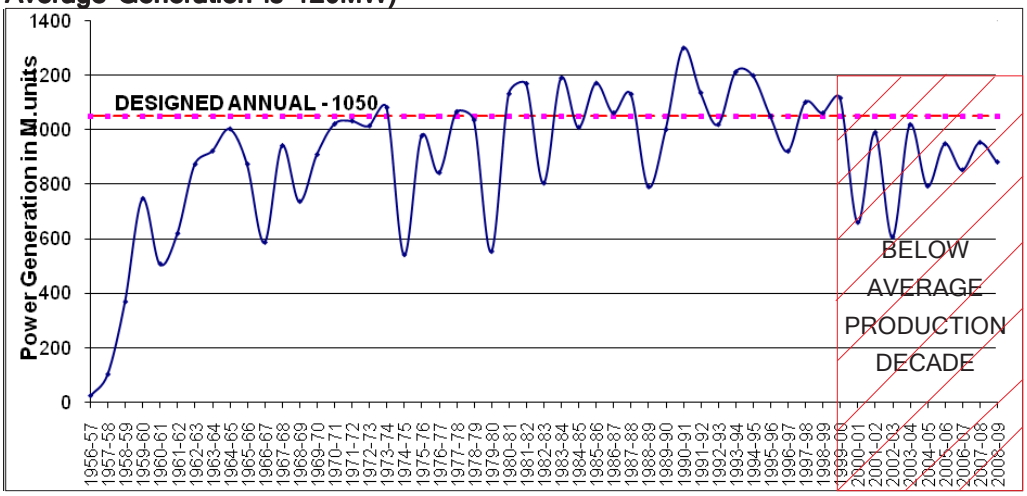
Hydropower generation from the Hirakud reservoir was the major priority in the project report of 1952, and also the key driver for reservoir operation till 1991. The plan for lift irrigation schemes was abandoned due to its possible impact on hydropower generation from the dam. The hydropower generation capacity of the reservoir in the years after dam construction was 270 MW, which was increased to 348 MW through the establishment of new equipment and renovation work. The reservoir has two power generation houses at Burla and Chiplima, with capacities of 260 MW and 72 MW electricity generation respectively.

Table 6.5: Hydropower generation from Hirakud Reservoir (GoO,2009)

Capacity	Original	Revised
Installed capacity at Burla	4 x 37.5 MW = 150 MW	2 x 49.5 = 99 MW
	2 x 24 MW = 48 MW	2 x 37.5 MW = 75 MW 2 x 32.18 MW = 64.36 MW 1 x 37.5 MW = 37.50 MW
	Total 198 MW	Total 275.86 MW
Installed capacity at Chiplima	3 x 24 MW = 72 MW	3 x 24 = 72 MW
TOTAL	270 MW	347.86 MW

Power production, which was at its peak during the 1980s, has gradually gone down. According to the Jayaseelan Committee report, the average power generation from the Chiplima power house remained 10 MW from 2002 to 2007, which is only 15% of its total installed capacity (GoO, 2007). Against the original plan of 1,524 million units of electricity generation from the dam, the annual average production as of 2006 was about 948.65 million units, which was 62.24% of the plan (GoI, 1947: 59-65; GoO, 2006: 40).

Fig. 6.4: Power generation from Hirakud project (MU) between 1956-57 and 2008-09 (According to the Evaluation Committee Report (1962), Designed Daily Average Generation is 120MW)



According to the Jayaseelan committee, an allocation of 0.500 MAF per annum to industries would result in a loss of power generation (0.334 MAF in the non-monsoon period) of 46.90 M units. The cost of power loss per annum at Rs. 1.00 per unit was estimated as Rs. 4.69 crores (GoO 2007).

Irrigation

After water was first impounded in the Hirakud reservoir in 1957, direct irrigation from the reservoir started through three main canals: Bargarh, Sason and the Sambalpur distributary. These canals irrigate parts of the Sambalpur, Bargarh and Sonepur districts of Odisha. The Bargarh canal emanating from the right dyke of the reservoir is the largest canal, irrigating major parts of Bargarh and Sonepur districts. The discharge capacity of this canal is 108 cumec, and the ayacut area is about 134,000 ha. The Sason canal emanating from the left dyke is the second largest with a capacity of 17.8 cumec water discharge, and ayacut area of about 21,000 ha in the five blocks of Sambalpur district. The Sambalpur distributary is the smallest canal emanating from the left dyke, with a capacity of 3.40 cumec, and ayacut area of about 4,100 ha.

During the commissioning period, direct irrigation from the reservoir was 160,000 ha in the Kharif season, and 106,000 ha in the Rabi season.[10] The water released after power generation is used for irrigation in the delta region of the river basin. 303,000 ha is irrigated in the Kharif season, and 169,000 ha in the Rabi season. (GoO, 2007: 23)

Table 6.6: Direct irrigation from Hirakud Reservoir (GoO,2007:23)

Name of the canal	Length (km)	Discharge (cumec/cusec)	Irrigation (ha/Ac.)
Bargarh Canal	88	108.21/3818.5	1,33,539/3,30,048
Sambalpur Distributary		3.40/18.0	4099/10,131
Sason Canal	22	17.84/614.0	21,468/53,058
Total		129.45/4450.5	159,106/393,237

According to the project report of 1947, there was a provision for lift irrigation and subsidiary reservoir formation below Hirakud near Chiplima (GoI, 1947).[11] These ideas were abandoned by the evaluation committee for the Hirakud reservoir in 1963.

Tank irrigation was a major irrigation source in the command area before the Hirakud project[12]. The canal irrigation system promoted after the dam did not attempt to integrate traditional tank irrigation systems. During the commissioning period, there was a lack of water utilisation from the irrigation system, as traditional tank irrigation systems served the needs of the traditional cropping pattern in practice. High Yield Varieties (HYV) of rice were introduced in the command area during 1963. The introduction of HYV in the command area increased water utilisation and doubled the cropped area. At present, there is a lack of any other irrigation option in the command area. Most of the traditional water bodies have disappeared or have been degraded, and their catchments have been converted to paddy lands.

Project report 1953 of the Hirakud reservoir had prescribed the following cropping pattern.

[10] However, according to the data of the Water Resources Department, GoO, the gross area irrigated as well as area under irrigation in Kharif and Rabi, is now more than the designed area. There has been considerable increase, more that 50%, in the Rabi irrigated area.

[11] This project report says that the height of the dam will be 625 feet, and 8 lakh acres will be directly irrigated through gravity flow and four lift points in western Odisha. The Advisory Committee of 1948 also recommended lift irrigation schemes and detailed canal surveys for an irrigation area of nearly 8 lakh acres. The project report of 1952 recommended the same for direct irrigation.

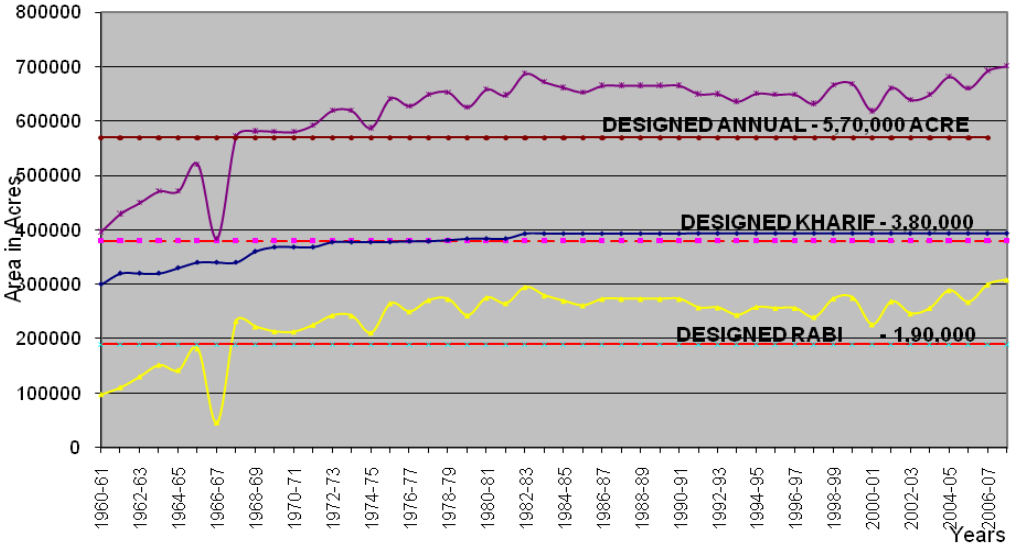
[12] Sambalpur gazette document

Table 6.7: Prescribed irrigation percentage in Hirakud command (GoO, 2007)

#	Crop	Kharif	Crop	Rabi
1.	Paddy	70%	Paddy	33%
2.	Sugarcane	10%	Wheat	10%
3.	Other	20%	Other	5%
	Total	100%	Total	48%

Initially, direct irrigation from the reservoir was 159,100 ha in Kharif and 106,820 ha in Rabi through three main canals, two on the left bank and one on the right. In 2007, the Kharif and Rabi paddy coverage was 98% and 70%, as against the prescribed 70% and 33% respectively of the ayacut area prescribed in the project report. The Rabi paddy area coverage in the Hirakud system is the highest for any command in India (WRD, 1999).

Fig. 6.5: Actual and design irrigation area season-wise between 1960-61 and 2006-07



There is a significant increase in the irrigated area in villages situated in the head reach of the command area. The villagers have brought non-command *gochar* (grazing land), *gramya jungle* (village forest), and *kata* (water bodies) lands under paddy cultivation in this area, and have diverted irrigation water to these lands. Unauthorised cultivation on government lands, lands acquired for canals, *gramya jungle* and *gochar* land accounts for 10% or more of the total irrigated area (WRD, 1999). While the irrigated area is increasing in the head reach of the irrigation system, it is decreasing in tail end areas.[13] Some villages do not follow the land settlement and consolidation decisions. They continue to cultivate old lands, though they are paying cess according to the settlement reports for new lands. As a result, there is a huge difference in de-facto and de-jure irrigated lands.

The Kharif irrigation is supportive irrigation according to the Orissa Irrigation Rules of 1961.[14] In most cases, the basic canal infrastructure is absent, which makes supply of irrigation water during Kharif difficult. There is a lack of maintenance and renovation of irrigation systems beyond cross bunds[15] for Rabi irrigation planning.

At present, the direct irrigation provision from the reservoir is about 1.6 lakh ha (GoO, 2007), against the promised 3.2 lakh ha in the project report (including lift irrigation).

[13] There was an absence of irrigation water supply in 28 villages of the Huma tail command region for the Rabi irrigation programme (2010-11). The Mirgamunda revenue village of Maneshwar gram panchayat in the Maneshwar block of Sambalpur district has irrigated areas in the tail ends of the Rasanpur minor. In 2010 Kharif, there was crop loss in the village due to lack of irrigation.

[14] According to Section 18A of the Rule, first class irrigation guarantees 28" of water in case of failure of normal rainfall.

[15] Cross bunds have been constructed in the canal by the administration, beyond which water is not made available for irrigation, though the area forms part of the command.

According to another estimate, against a target of 1,094,953 acres (including delta and lift irrigation), 611,583 acres which amounts to 55.85% of the target, is annually irrigated (GoI, 1947: 59-65; GoO, 2006: 40, as quoted in Nayak, 2010). On the one hand, according to media reports, the original demarcated command area of 25,567 ha of the Sason canal and Sambalpur distributary has now shrunk to 17,199 ha. On the other hand, the data of the state Water Resources Department indicates an increase in the gross area irrigated as well as the area under irrigation in Kharif and Rabi compared to the designed area in direct command.

While the promised irrigation from lift arrangements and the subsidiary reservoir could not materialise, and delta irrigation could not be fully optimised, an increase in water use in the direct command through increased cropping intensity and domination of paddy cultivation has been reported. However, direct interaction with farmers in the Sason command and media reports point to shrinking of the actual irrigated area in the command, conflicts between head and tail, and conveyance and irrigation inefficiency.

Allocation to Industry

Industrialisation had begun in undivided Sambalpur district in 1900, after the construction of the Bengal Nagpur rail track and discovery of coal in the Ib valley. Initially, there were underground coal mines in the Rampur coal fields. The Birla group started the Orient Paper Mill at Brajrajnagar in 1937 using available bamboo in the nearest forest region. However, the construction of the Hirakud reservoir initiated a new process of industrialisation. With the support of ALCAN, an international aluminium company from Canada, the Indian government started the first aluminium smelter at Hirakud in 1957. The electricity was supplied from the hydropower generated from the Hirakud reservoir. Other industries such as the Hirakud rolling mill and the Hira cement factory were established in the same period. Due to the increasing production of paddy in the direct command, a number of rice mills also came up in the region (OSPCB, 2007).

During 1980s, with support from the state government, many sponge iron units were established in the peripheral region of the reservoir. In Sambalpur district, Samaleshwari Sponge Iron and Rathi Steel are the major sponge iron industries. In Jharsuguda district, Aryan Ispat, Eastern Power and Steel, and Shyam DRI Steel are the major units.

Table 6.8: Industrial units drawing water from Hirakud reservoir before 1990 (GoO, 2007 : Annexure -E)

#	Name of the organisation	Units of water in cusec per day
1.	Sambalpur P.H.D. (Drinking water)	0.300
2.	Aluminium Co.	1.190
3.	Industrial use of Aluminium Co.	0.340
4.	Arun Rice Mill	0.015
5.	Hirakud Rerolling Mill	0.803
6.	Sambalpur Oil Mill (Baraipalli)	0.020
7.	Hira Cement Factory (From Bargarh Main Canal)	1.577
8.	Hirakud Rice Mill	0.200
9.	Sugar Mill (Only 80 days in a year)	0.290
	Total	4.599 cusec

Table 6.9: Industrial units drawing water from Hirakud reservoir before 1990 (GoO, 2007 : Annexure -E)

#	Name of the agency	Units of water in cusec per day
1.	Ib Thermal Power Station	123.62
2.	Proposed Thermal Power Station (Hirma Site)	160 to 170
3.	M/s. Indal Limited	10.00
4.	South Eastern Coal Fields Ltd.	1.85
	Total	305.47 Cusecs.

In the original project report of the Hirakud dam project there was no allocation of water to industries. However, subsequently, water began to be supplied to industries such as Indian Aluminium Company (INDAL), Tata Refractories, Orient Paper Mill, and railways along with drinking water to Sambalpur town. The amount of water taken from the reservoir for purposes other than agricultural was negligible[16] till 1986.

After 1990, thermal power based industries were introduced in the region. The Odisha Power Generation Corporation (OPGC) started its 440 MW Ib thermal power plant in 1998. After this, alumina industries with captive power plants such as Vedanta Alumina established their units in 2005. Recently, HINDALCO took over INDAL and expanded alumina production capacity by ten times. There are nearly 35 small and major industrial establishments around the reservoir. Bhushan Power and Steel came up with the biggest steel producing unit in the region in 2005. It may be mentioned that the water intake point of Bhushan Power and Steel in the upstream region of the mouth of the Sason canal was the target of famers' anger because it was causing water shortages in the Sason command during 2005-07, which resulted in large-scale agitations by farmers.

Heavy industries such as sponge iron steel, alumina, coal washeries and thermal power plants are major consumers of water from the Hirakud reservoir. Thermal power plants including captive power plants account for nearly 80% of the total water allocated for industries from the reservoir. Vedanta Alumina has a 700 MW captive thermal power plant with a requirement of 54.9 cusec; Bhushan Power and Steel has a captive thermal plant with coal washeries, having a requirement of 70 cusec. The Odisha Power Generation Corporation's (OPGC) 420 MW Ib thermal Power plant requires 65.34 cusec, though at present it is using only 12.30 cusec. The small sponge iron and steel plants have their own captive power plants, with capacities ranging from 10 to 30 MW.

The annual allotment of water for industrial use from the reservoir by the Government of Odisha in 1990-91 was 0.35 MAF (12.35 cumec).[17]Applications for another 0.183 MAF (6.46 cumec) from five industries were then pending. The water demand for industrial use started to increase from the year 2000 because of industrialisation spurred by neo-liberalisation which has been picking up speed in Jharsuguda and Sambalpur districts. In response to a memorandum submitted by the Hirakhand Citizen Council in July 2006, a Technical Expert Team indicated a threat to power generation due to industrial water allocation. In 2007, the Jeyaseelan committee recommended allocation of 0.500 MAF (17.64 cumec) per annum until further review, say after five years (GoO, 2007).[18] In 2010, the Water Allocation Committee (WAC) of the state government allocated 1419 cusec (1.1 MAF; 38.96 Cumec) of water to 61

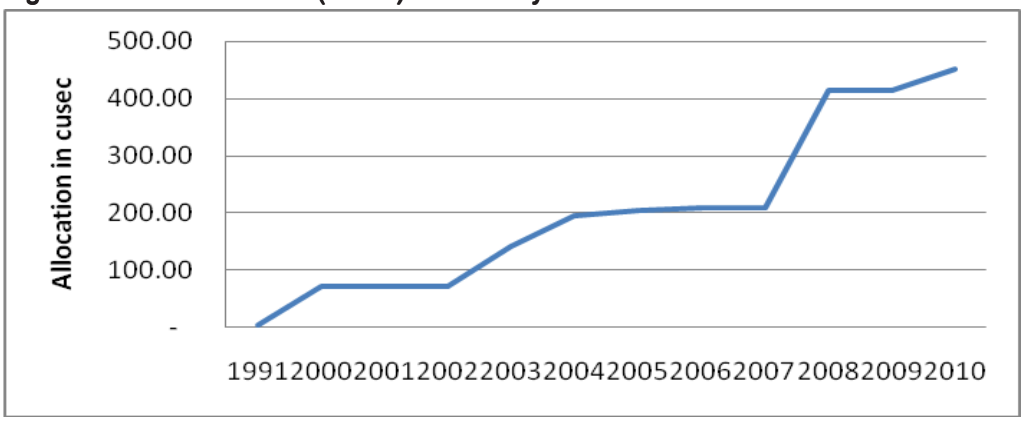
[16] According to Karunakar Supkar, Retired Chief Engineer of Hirakud Dam Project, industrial water intake from reservoir was nearly 20 to 23 cusecs.

[17] The Government of Odisha Water Resources Department have allocated 0.350 MAF (483 cusec) of water from the Hirakud reservoir for industrial use vide Lr. No. Irr-222-HKDW-6/90-40945.

[18] It also recommended that water actually drawn shall be charged at fixed rates along with compensation for the loss of power generation because of the water consumed from October to May. The industries could draw water up to a reservoir level of 592.0, below which it may not be possible to draw water from the reservoir. The industries should aim at creating backup storage for about a month's minimum requirement during the dry season.

industries and other organisations, in addition to other industries which were allocated water prior to formation of the WAC, of which, allocation from the Hirakud reservoir is about 500 cusec of water (0.4 MAF; 13.91 cumec).[19]

Fig 6.6: Water allocation (cusec) to industry from the Hirakud reservoir



With the planned entry of aluminium and thermal power plants by the year 2031, the present level of water withdrawal will increase 20 times to 2143 million litres per day (MLD). This projected level of water withdrawal is estimated to be 0.645 MAF (22.6 cumec) per year, considering the present plan of the government to allocate 0.35 MAF/0.5 MAF per year. Industries like iron and steel, thermal power and aluminium plants being high temperature operations, 90% of water is expected to evaporate, and only 10% would return as effluents from these industries (OSPCB, 2010b).

The state government is signing new MoUs for upcoming industries in the region, which will demand water from reservoir. At present, Ind Bharati (Utkal) Power has started work to build a 700 MW capacity thermal power plant near the Ib thermal plant which will take water from the reservoir. Due to the additional demand of water intake by this plant and upcoming industries in the region, the total demand of water from the reservoir will increase beyond 0.350 MAF. NTPC and other heavy industries are also in the process of establishing their plants in the Jharsuguda region. Add to this the trends in reservoir siltation, reduced runoff and failure in reservoir filling, and we may see that it is not implausible that industrial allocations may directly affect irrigation and drinking water supply downstream of the reservoir.

Apart from increasing legitimised allocation through the state, industries are also hegemonising their territorialisation over the reservoir space by occupying key locations with strategic high hydro potentials, constructing illegal infrastructure, blatantly pilfering water from the reservoir, and ensuring that the state machinery remains a silent spectator or tacit supporter[20].

[19]According to the data available at http://www.dowrorissa.gov.in/WaterPricing/WaterPricing.pdf; According to the hydrology department, Hirakud Dam Circle, Burla, 15 industrial units have been allocated water from the reservoir. The amount of water allocated from the reservoir is 471.952 cusec (0.34310 MAF), out of which industries are taking 200.542 cusec (0.14600 MAF) of water.

[20] Down To Earth, 2007.In June 2005, while exploring the reason for water not reaching the Sason canal, farmers found out that the Bhushan steel plant in the vicinity had built a 2 km-long *kuchha* road up to the reservoir to access its water off-take point. The off-take point is where the tributary Ib merges with the reservoir. This area also forms the canal head. With the road obstructing the flow of water from the Ib and the company lifting most water, the canal head was left dry. The same situation prevailed in 2006. The local magistrate threatened to stop water to Bhushan Steel if the road was not destroyed. Interestingly, Vedanta is also setting up a water lift-off facility in the same area. The company's contractor was laying the pipes without any notice or permission from the dam authorities, even though the area is highly restricted. The villagers stopped the work. A few other companies are also setting up water-lifting plants in the same area. The state government's own technical committee set up to examine Vedanta and Hindalco's water off-take plants recommended in August 2007 that their locations would impact water availability for agriculture. The locations have, however, not been changed. Vedanta is now working on a second water pipeline along the existing one.

These increasing and multiplying trends of accumulation or privatisation by the industry, at the behest of the state, in violation of its own manifest policy (allocation prioritisation according to Odisha Water Policy, 2007), resonate with the growing instances of water injustice in the neoliberal economy in other parts of the globe (OWPO, 2007). The role of the state as the central actor in establishing and maintaining "market principles", and "regulating" and "organising" privatisation is aggravating the injustice (Swyngedouw, 2005). While the state has to some extent set up institutions and norms to ensure fairness and justice in allocation, its behaviour in executing these institutional norms has violated procedural and distributional justice. [21]

Time and again, the state government has declared that the irrigation demand will be fulfilled on a priority basis and only then will the remaining water be utilised for power generation. The state government has stated that the irrigation potential of the Hirakud reservoir would not be reduced if water up to 0.350 MAF/year is provided to industries, though power generation would be affected during the non-monsoon period. To win the support of farmers, the Chief Minister has also made several promises – 'not a single drop of water to industry', 'if required dam height will be increased', 'dredging of reservoir to increase storage', etc. (Down to Earth, 2007). However, given the industrial development in this area, the farmers are apprehensive that there will be less water for irrigation.

Environmental Flow

The Mahanadi basin is one of the 30 river basins in the world marked as global level priorities for the protection of aquatic biodiversity by Groombridge and Jenkins due to their extensive and continuing development (Groombridge and Jenkins, 1998). It is categorised as "strongly affected" by flow fragmentation and regulation (Nilsson et al., 2005, quoted in Smakhtin and Anputhas, 2006). Adverse hydrological and hydraulic impacts of the Hirakud dam on the Chilika lake in terms of reduced flushing capacity, increased sedimentation and clogging of the mouth, increase in salinity, etc., have been highlighted by Das and Jena (Das and Jena, 2008).

According to the water policy of Odisha, 2007, the environmental flow in rivers is accorded second priority, after drinking water supply. For conservation of river biodiversity and riparian rights, there is a need for continuous water flow of a substantial amount in the river. The flow in the Mahanadi river downstream of the reservoir is mainly dependent upon water released after hydropower generation from the reservoir. The recent reduction in hydropower generation from the reservoir is reducing water flow in the river.

The seepage and leakage from irrigation systems also flows into the river. The water diversion from the Indravati project to the Tel river which meets the Mahanadi at Sonepur also increases water flow in the Mahanadi river downstream, but this amount depends on hydropower generation from the Indravati reservoir. In 2011, the water stored in the Indravati reservoir was below 50% of its capacity, resulting in a fall in hydropower generation. The downstream flow in the Mahanadi depends mainly on hydropower generation from the Hirakud and Indravati reservoirs. However, this amount does not seem to be sufficient for environmental purposes.

[21] Through provisions of state water policy, formation of different committees and development of rule curves for reservoir operation, responses in the state legislative assembly and assurances by people's representatives to not allocate water to industries

Drinking Water

According to the water policies of 1994 and 2007, drinking water has the first priority in water use. The state water plan of 2004 also emphasises that "the maintenance of good water quality to ensure public health and prevent damage to the environment; the availability of safe drinking water and water for sanitation for all; the attainment of food security" is the main objective of the state water plan. According to the Hydrology Department of the Hirakud Dam Circle, 7.46 cusec water is provided for drinking and domestic use to Sambalpur, Hirakud and Burla towns downstream of the reservoir. The reservoir water quality falls under B- Category water which can be utilised for outdoor bathing (OWPO, 2004). The degradation of water quality of the reservoir is a major concern for the citizens of Sambalpur town and its surroundings.

According to a retired electrical engineer of the Hirakud power station, in May 2010, the water supply for drinking to Sonepur, Boudh and Bolangir towns in the downstream was reduced because water was diverted for hydropower generation. In his opinion, the water level of the reservoir is kept at 595 feet, while the dead storage level is 590 feet. The dam authorities do not utilise five feet of water for power generation[22], since this water is required for drinking and sanitation purposes in downstream towns and villages.

Reservoir Operations Management and Rule Curve

The main objective of the Hirakud dam was flood control, whereas irrigation and hydropower generation were secondary. Perhaps, since the construction of the dam only for controlling floods was not economical, the dam planners designed it as a multipurpose project which would provide other benefits. To meet multiple needs, it was required to keep the water level in the reservoir as low as possible in the monsoons so that flood water could be stored and discharged in a regulated manner. Also, the dam would have to be filled to its Full Reservoir Level (FRL) by the end of the monsoon so as to provide water for irrigation, drinking, and hydropower generation.

For managing reservoir operations throughout the year to control floods and assure availability of water in the reservoir at the end of the monsoon for other purposes, different committees prescribed rule curves for raising and lowering reservoir levels in specific periods. The first rule curve was recommended by the Reservoir Operation Manual of 1957. In 1976, a team of experts constituted by the Government of India, Ministry of Agriculture and Irrigation recommended another rule curve with a focus on agriculture.

After the third study on sedimentation in the Hirakud Reservoir in 1986, it became clear that the rate of sedimentation was higher than expected. This affected reservoir operations for storing water and moderating floods. The changing rainfall pattern in the catchment was also influencing runoff patterns into the reservoir at the end of the monsoon. Due to these problems, the Central Water Commission constituted another rule curve committee of experts in 1988. This committee analysed all information related to the pattern of rainfall, runoff into the reservoir, floods in the delta region, and sedimentation in the reservoir, and recommended a fresh rule curve to manage reservoir operations.

[22] Media statements given by Retired Electrical Engineer of Hirakud Dam Projects during 2010.

The rule curve as prescribed by the committee in 1988 is being followed to this day. It allowed for flood regulation by the reservoir during the peak period of the monsoon by lowering the reservoir level to the dead storage level. Also, from the first of August as the monsoon nears its end, it recommended a steady rise in the level of the reservoir within upper and lower limits to fill it up to the full reservoir level (FRL) on 1st October, subject to some factors given below.

The proceedings of the rule curve committee also say that "during course of actual operation, specifically towards late monsoon period the project authorities will at least consider the following before deciding reservoir levels within these limits:

1. The general long term meteorological forecast issued by Indian Meteorological Department (IMD) on the likely trend of the monsoon.

2. The starting date of the monsoon inflow into the reservoir, the predicted duration, and pattern of inflow into the reservoir.

3. The likely base flow into the reservoir during the monsoon."[23]

There is a provision for a pre-depletion plan, according to which dam authorities should lower the reservoir water levels below the prescribed limit in the following situations:

1. Satellite image of cloud formation.

2. IMD forecast indicating general monsoon trough, storm track, speed of storm, translational velocity, strength of circulation and its location.

3. Topography of the basin and its surrounding area with respect to storm characteristics and IMD prediction of quantitative precipitation.

4. The average rainfall calculated from daily/3-hourly rainfall records of 40 stations in upper catchment and 31 stations of the lower catchment.

5. The runoff records from gauging stations in the upper catchment give inflow values though approximate, 48 hours in advance of reaching the dam site.

6. The runoff records from gauging stations in the upper catchment give inflow records 24 hours in advance of reaching the dam site. The runoff from the lower catchment at the delta head can now be predicted from the rainfall records about 60 hours in advance.

7. If the releases from upstream reservoirs are intimated in advance, this will further help the reservoir operation.[24]

[23] Agenda note and proceedings of the third meeting of the Rule Curve Revision Committee, January 1988, Page no. 3

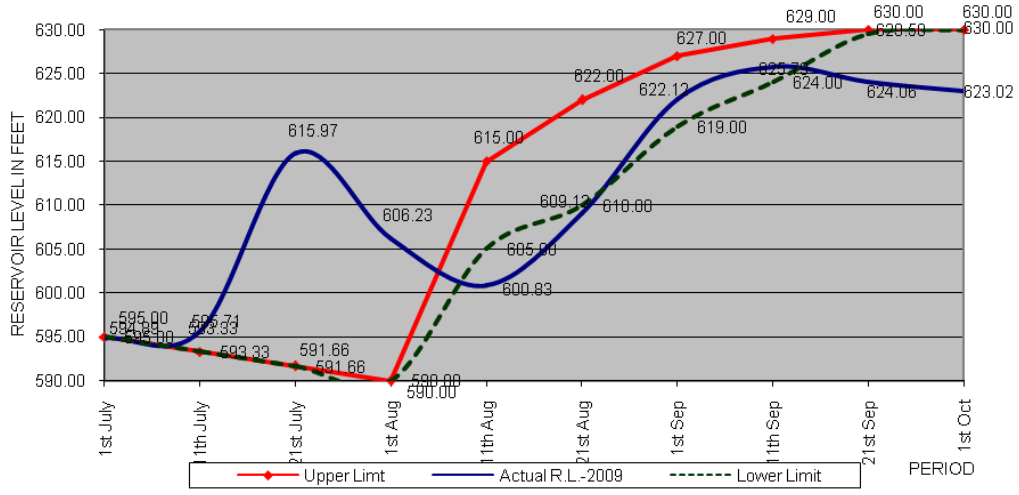
[24] Agenda note and proceedings of the third meeting of the Rule Curve Revision Committee, January 1988, Page nos. 3, 4

Table 6.10: Rule Curves: The Changing Priorities

Aspects	Reservoir Operation Manual, 1958	Committee by Ministry of Agriculture and Irrigation, 1976	Committee appointed by the Central Water Commission in 1988
Scope	Indicative reservoir level at beginning of different months		
Beginning of Monsoon	591.2 on 1st July		590 to 595 ft during 1st July to 1st August
During Monsoon	590 ft which is close to the dead storage at the beginning of August and September, during monsoon	610 ft on and up to 10th August, and then increasing it every 10th day so as to reach 627 ft on 21st September	From 1st August start filling the reservoir
End of Monsoon	630 ft at the beginning of October and November (towards the end of monsoon)		1st October, reservoir will be filled up to FRL
Mentioned or Perceived Focus (our interpretation)	Flood cushioning	Irrigation	Flood control during monsoon and maintenance of reservoir function (irrigation and power production) post-monsoon

However, there are a number of incidents when the reservoir level was not maintained according to the prescribed rule curve. During the 2009 floods, it was clearly seen that the reservoir level was not maintained according to the prescribed rule which resulted in a flood in the delta region.

Fig. 6.7: Actual and rule curve prescribed reservoir levels (ft) in 2009



Managing the reservoir according the prescribed rule curve of 1988 is becoming more difficult for dam authorities with changing rainfall and runoff patterns. There are incidents when the runoff into the reservoir increases suddenly, forcing the dam authorities to reduce reservoir levels to moderate floods. When runoff into the reservoir decreases sharply, however, there is no water to fill the dam up to FRL at the end of the monsoon. At times, if the reservoir is maintained at FRL at the end of the monsoon, erratic rainfall in the catchment forces the dam authorities to release more water, leading to floods. Subsequently, in case of less rain, the reservoir remains empty. Increase in such erratic rainfall conditions is making reservoir operation risky

and challenging (OWPO, 2004). The dam authorities are struggling in every season to control floods, maintain reservoir water and safety, and fill the reservoir up to FRL on 1st September.

The changes in seasonality and variability of runoff into the reservoir are going to be further compounded due to the projected impact of climate change. There is a need to modify reservoir operations to adapt to changes in the stream flow. It is necessary to emphasise that the reservoir operation rules should be soundly adapted to global climate change as well as economic activities in the river basin. Modelling options suggesting tradeoffs between irrigation, flood control and power generation to rationalise reservoir operation in the changing economic and climatic contexts are also being recommended. However, one also needs to take note of the fact that dams are becoming testing grounds for utilising hydrological research and modelling aimed at precision forecasting of water availability and demand to enable liberalisation, privatisation, globalisation (LPG) dictated 'rational' reservoir operations for maximising economic gains in the neoliberal era. Higher predictability of hydrological behaviour will facilitate commodification of water and make it easier for markets to trade water, and hydropower and industrial use will be prioritised at the cost of flood control and irrigation.

The irrigation water demand reduction can be achieved by changing the cropping pattern and improving the irrigation system. The relaxation in the rule curve reduces flood storage reserve capacity by 3000 MCM, which may decrease the flood regulating capacity of the reservoir. Flood control and regulation is a complex phenomenon; the flood water inflow can suddenly increase to more than 1000,000 cusec within 48 hours. The lack of flood water storage in the reservoir during such conditions will result in the discharge of more water from the reservoir without any regulation. Increase in the storage capacity of Hirakud has also been suggested citing the fact that the ratio of annual inflow to reservoir capacity is very high (over five times) for Hirakud, with spills occurring every year during the monsoon months. Protagonists have suggested exploring this option as this would also provide higher storage for meeting other demands (Raje and Mujumdar, 2010).

There have been suggestions to marginally sacrifice the reliability with respect to irrigation and flood control in order to increase hydropower reliability and generation in future scenarios. This is argued as an option to revise reservoir rules for flood control in basins where climate change projects an increasing probability of droughts. However, power generation would also be difficult to restore due in part to the large projected increases in the irrigation demand (Raje and Mujumdar, 2010).

In terms of the decision making methodology, the problem of ineffective operation of existing reservoirs using outdated technology and highly subjective management practices has been repeatedly indicated by many specialists in recent years (Guariso et al., 1986; Oliveira and Loucks, 1997; Chen, 2003; John, 2004). Reservoir operation has been shifting rapidly from traditional modes based on heuristic procedures through use of rule curves derived through intensive simulation techniques (Chang et al, 2005) and operator's subjective judgements (Ngo, 2006) , to the use of optimised strategies, taking advantage of the rapid development in computational techniques like genetic algorithms (Chang et al, 2005).

Need of Revisiting Rule Curve, 1988 : An Analysis in the Context of the 2011 Flood

This rule curve permits rising of the reservoir level between upper and lower permissible levels from the 1st of August to the 1st of October, so that the reservoir will be filled up to the full reservoir level by the 1st of October. The rule curve committee concluded that the monsoon starts to retreat from the first week of August, and during this period, there will be a lesser chance of floods in the Mahanadi river. However, the 2003, 2008 and 2011 floods occurred in the August to September period when the water level prescribed in the rule curve remained at higher levels, reducing the flood moderation capacity of the reservoir.

In 2011, in spite of a warning of low pressure formation in the Bay of Bengal, no depletion plan was prepared by the dam authorities right from 1st of September, 2011, and water levels were kept close to 624 ft near FRL. The water level remained nearly at this level right up to the 6th of September. Even though heavy rains in certain pockets of Chhattisgarh in the catchment were reported, and it was predicted that there would be peak inflow into the reservoir, water discharge from the dam was reduced by closing the sluice gates. Only on 7th September, when the inflow into the reservoir started to increase and the water level rose to 628 feet, was the water discharge from the reservoir increased. From 8th to 11th of September, 55 sluice and 4 crest gates were opened, and there was a peak outflow of more than 9 lakh cusec. This resulted in a peak flow of 13.64 lakh cusec of flood water at the Mundali gauge site near the delta, leading to one of most devastating floods in the state, which badly damaged 19 out of 30 districts, affected 5 million people and taking a heavy toll on life (80 human casualties), and property (1.5 lakh ha of crops affected; Rs. 21 billion loss).

Allegations, analysis and debates across the entire media space from e-groups to print and electronic media pointed fingers towards the way the reservoir was managed before and during the flood.[25] The Governor M. C. Bhandare, asked the state government to investigate the alleged mismanagement of the Hirakud dam in triggering this flood. Shrikant Jena, the Union Minister of State for Chemicals and Fertilisers also asked the CWC to conduct a probe into the implementation of stipulated rules for managing operations of the Hirakud reservoir.

The Odisha State Centre of the Forum tried to analyse the 'Rule Curve' based reservoir operation of Hirakud, to see whether the violations in the rule curve prescriptions added to the flood severity and woes, or whether the 'Rule Curve' itself needed modification with changing circumstances in the dam's catchment, and the changing reservoir capacity. Based on a rapid analysis of the rainfall, runoff, siltation, reservoir level data over about 50 years (1957-2009), the post-Hirakud water resources development trends in Chhattisgarh which contributes to 89.9% of the dam's catchment, and daily observations during the 2011 flood, it made an appeal that the 'Rule Curve' developed in 1988 be revisited, to adapt it to the changing climatic and development context. The Odisha State Centre of the Forum also pointed out the need to explore a formal arrangement with Chhattisgarh for the management of water and information about water in the Mahanadi basin. It also suggested to the state that it should ensure the active participation of civil society, primarily the representatives of the affected stakeholders of the basin, both in the Hirakud downstream and delta, in these two processes, for developing a more inclusive, effective and adaptive system for flood management.[26]

[25] 'Rule Curve Violated; Water kept for Industry caused flood' – Bijay Mahapatra (Ex-leader, Opposition, State Assembly); 'Govt ignored forecasts by Met. Dept. and Satellite observations related to heavy rain in catchment of Hirakud reservoir' – BJP; 'Flood is Man-made; due to callousness and carelessness of the State administration' – Congress and BJP; 'Had the Hirakud dam properly managed the flood could have been avoided'- public interest litigation (PIL) filed against the CE, Hirakud dam, Secretary, WRD, Energy, SRC & CS; 'State has failed to control the flood situation and not been able to manage the relief operations properly. The cause and intensity of current floods need to be analysed; due to siltation more damage by medium to severe floods – Damodar Rout (Senior Ruling Party Leader)

[26] The report was widely covered by the media. Media reports are available at http://orissadiary.com/ShowOriyaColumn.asp?id=29076, http://asiancorrespondent.com/65941/odisha-floods-dams-retained-waters-to-serve-industry-during-dry-months/, http://www.bizodisha.com/newsdetails.php?newsid=366, www.scribd.com/doc/64570561/Press-Release-on-Rule-Curve

Rehabilitation

A total of 22,144 families, with a population of about 1.1 lakh to 1.6 lakhs in 249 villages in the then Sambalpur district, Odisha, and 26 villages of Raigarh district of Chhattisgarh were affected due to the Hirakud reservoir. The exact number of people displaced/affected by this project is yet to be ascertained correctly. Out of the several issues attached to this mega project, the problem of displacement has been paid the least attention by the planners. While laying the foundation stone, Nehru told the villagers, "if you are to suffer, you should suffer in the interest of the country". There was a huge loss of forest, flora and fauna, fertile land, mineral deposits, and historical monuments. Even after 50 years, more than 3500 cases of compensation are still pending disposal.

During dam construction, the Hirakud Land Organisation (HLO) was formed for settling issues of displacement due to reservoir submergence. The compensation amount was nominal, starting at Rs. 12 per acre in 1952.

For resettlement of the displaced people, 18 rehabilitation camps were set up in the region, out of which 16 were then inhabited and two were not inhabited. Government documents reveal that 2243 families were rehabilitated in these camps. The displaced people were promised better housing, road connectivity, electricity supply and irrigation water. However, these camp sites were established by clearing forest land, and the displaced people were given low grade barren land. There was a lack of basic services at the camp sites. These camps were situated away from the command area. Due to the absence of basic amenities and irrigation facilities at the camp sites, these were abandoned. People left the camp sites in search of livelihood options. At present, most of the camps are uninhabited and ruined. The displaced people who lost their livelihood due to the construction of dam are deprived of its benefits. In 1987, though the then Chief Minister J. B. Patnaik accepted in the Assembly that 1912 riot families did not receive full compensation, it was later estimated that only 1447 families did not. During Biju Patnaik's rule, some displaced families were provided token compensation, and a list was prepared of those who did not get any compensation.

There was acquisition of land up to Reservoir Level 632 ft, and at some places up to RL 634 ft. When the FRL was finalized at 630 ft, a large chunk of land remained as surplus with the Water Resources Department in the peripheral region of the reservoir. Most people who did not find the rehabilitation camp suitable, settled on the surplus land along the periphery of the reservoir. The surplus lands were also distributed among various agencies including the Central State Farm (Hirakud)[27], Jharsuguda which was allotted 10,000 acres. Most of these lands are in the Lakhanpur and Jharsuguda tehsils of Jharsuguda district. The displaced families settled on these lands and started to cultivate them, and also fished in the reservoir water. The settled families were now treated as encroachers on the reservoir land. At present, there are 21 non-revenue villages in the peripheral region of the reservoir in Lakhanpur, and 13 non-revenue villages in the peripheral region of the reservoir in the Jharsuguda tehsil of Jharsuguda district. Initially, the Water Resources Department used to lease lands to these farmers for cultivation on a yearly basis. The reservoir administration also discontinued leasing out this land for cultivation in recent years. These villagers have been struggling to get revenue village rights and land rights. They have also been demanding lift irrigation projects and anicuts on the back water of the reservoir to irrigate their fields.

[27] The farm was established by the Government of India in 1967. It was proposed to develop farm in and around the periphery and offshore of the reservoir. The objective was to produce hybrid seeds of maize, wheat, and vegetables, in order to meet the increased requirement of seeds during the fourth five year plan (1969-74). Sambalpur Gazetteer , 1971, page no. 160

It is very clear that the people displaced due to the construction of the dam did not get any share from the benefits of this multipurpose project. Not a single rehabilitated colony has been provided irrigation facilities from the dam water. The rehabilitation camps near the command area also did not get water for irrigation. The villages resettled around the reservoir were also not allowed to take water from it by the dam authorities. There are incidents of seizure of pumps and police cases against farmers who lifted water from the reservoir. Now, after the industrial water intake from the reservoir was challenged by the farmers' movements, the dam authorities do not seize pumps and register complaints against the farmers.

The displaced people of Lakhanpur block were united under the banner of the 'Budi Anchal Samiti, Lakhanpur', led by late Prasanna Kumar Panda, to fight for their rights. After construction of the dam, this movement mainly focused on land rights of the displaced people. They sent a number of memorandums and petitions to the state government about the land rights of the displaced people. This movement is still in progress, as many families have yet to get their land rights.[28]

In 2005, the Government of Odisha decided to provide 0.10 acre of homestead land to the displaced people. However, there is very little progress in this regard. On 22nd August, 2011, the Revenue Minister of Odisha declared that non-revenue villages in the peripheral region of the reservoir, falling between 630 to 632 Reservoir Levels will be regularised.[29] These villagers are presently described as encroachers and denied basic facilities for the last 53 years. Regularisation of their lands will take place after a joint survey and mapping of lands to be undertaken by the Revenue Department and Water Resources Department. Further, the Revenue Minister announced that the names of individuals who are yet to get compensation, would be displayed on the department website and at the nearest tehsil office. However, three years ago, the then Revenue Minister had also declared that the compensation process would be finalised by the end of the year, and that each displaced family would get 10 decimal homestead land.

With the recent declaration by the Revenue Minister, the Sambalpur Collector published a notice which envisages the steps to be taken to provide compensation for all those who lost their land to acquisition. Though the process is continuing for the last 10-15 years, this time the people expect more. According to the notice published by the Collector, the affected people should submit their application within 30 days in the Tehsil office.[30] Again, this notice is only applicable to those who are living in Sambalpur after displacement. However, critics point out that it may not be possible for people to produce all the documents required as proofs within 30 days, because all the records are maintained in district offices.

[28] After 1980, the displaced people started to struggle against displacement for a second time due to mining and industrial establishments such as the Lakhanpur and Belpahad open cast mines and the Ib thermal power station of the Odisha Power Generation Corporation (OPGC). The displaced people who possess some lands in the peripheral region are threatened due to the upcoming industrialisation which will displace them for the second time.

[29] The state government decided in 2011 to carry out a comprehensive survey of the villages falling between the heights of 630 ft and 632 ft above dead reservoir level and record the rights in favour of these villagers instead of the irrigation department. http://www.thehindu.com/todays-paper/tp-national/tp-otherstates/article2287316.ece

[30] According to a recent notice, if the displaced families fail to submit their applications with all the valid proofs within 30 days, the government will not pay attention to their case in the future. Critics ask why the government is in such a hurry. If people can wait for 65 years for justice, they ask, why can't the government wait for more than 30 days? In the recent notice, there is no mention of the timeframe for reimbursement. Even those who already applied for compensation of 10 decimal homestead land do not know the status, and this notice has nothing to say about this state of affairs. There is also no mention of the submerged region or of the increase in ex-gratia payment after the changing circumstances.

7

Chapter 7

The Hirakud Command: Increasing Shortages, Changing Crop Patterns and Deprivation of Tail Reaches

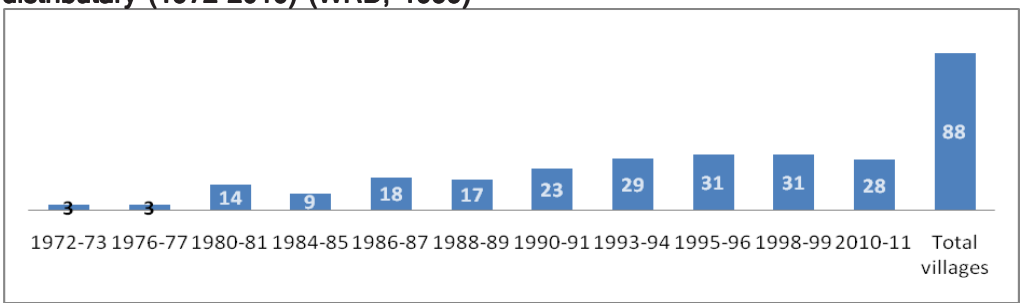
This chapter discusses the issues in the Sason canal command which was the epicentre of the Hirakud water conflict. The shortage in water supply to the Sason command area during 2005-07 led to an industry vs agriculture water conflict. Therefore, it is important to understand the basic issues related to irrigation, farmers, and farming in the Sason command. The work towards the resolution of water conflicts in Hirakud is strongly connected to resolving the irrigation issues within the Sason command. This chapter describes the present irrigation management and its implication for farming in the command area, water logging, cropping pattern, seepage and leakage, crop varieties and the situation of traditional water bodies, etc. The issues related to farmers and farming such as farmers' suicides, industrial pollution and crop loss, irrigation cess related issues, paddy procurement, land consolidation and reforms, reduction in agricultural production, overuse of chemical fertilisers and pesticides, Pani Panchayats, etc. are also discussed in this section.

Irrigation Water Management in the Sason Command

The irrigation in the Sason command area is supplied through a network of main canals, distributaries, minors and sub-minors. Water is supplied up to the sub-minor level, beyond which it is supplied through flood irrigation; the released water floods and flows from field to field in the absence of field channels. It takes almost 10 to 15 days for the canal water to reach the tail region. The majority of the command area is under paddy, which requires standing water in the fields. Therefore, flood irrigation is the preferred mode of irrigation.

In the Hirakud command area, water is not distributed equitably in the entire ayacut. According to the report on the Sason canal system (1999), about 50% of the land is over-irrigated, 30% of the land gets normal irrigation, whereas 20% of land at the tail end of the canal faces an acute scarcity of water (WRD, 1999).

Fig. 7.1: Number of villages not receiving irrigation water from the Huma tail distributary (1972-2010) (WRD, 1999)



To ensure equal distribution of canal water among the tail-end cultivators, the Hirakud Command Area Development Authority started the rotational system of irrigation, known as *Warabandi*, in 1984-85.[1] Based on a weekly rotational schedule ("*wara*" means a week, and "*bandi*" means turn), this programme aimed at providing water to each cultivator according to his crop's and field's needs. The authorities claim to have covered 12,411 ha in 72 villages by the end of 1987-88. However, by their own admission, the scheme has not fulfilled its objectives as "non-flow of design discharge at different outlets, non-maintenance of conveyance system and non-response of irrigation authorities pose problems in pursuing the farmers to share the irrigation water."[2] In 2007, the canal administration tried once again to implement '*Warabandi*' for managing irrigation in the Sason canal region. However, the water in the distributaries got blocked inside the head reach, resulting in damage to existing infrastructure. The '*Warabandi*' didn't work in head reach villages, and water could not be taken to the tail ends.

A discharge measurement system is missing at different levels of the irrigation system. The fields are only flooded up to the end of the season. Most of the time, the gates of the distributaries are operated manually. In most cases, the canal infrastructure is damaged at the minor and sub-minor levels, which results in poor conveyance. The Sason main canal is gravity based contour canal. Due to the geography of the region, during rains, the runoff from the left side of the canal spills into it, thus overtopping its embankments, mainly in the Huma tail distributary region. As a result, siltation occurs in the canal bed, and its conveyance capacity is reduced. During construction of the Sason canal system, it was assumed that the seepage losses from the canal would be 8.0 cusecs/M sq ft wetted area. At present, the seepage loss is about 15.0 cusec/M sq ft. During Rabi irrigation, there is a growth of weeds in the canal beds, which decreases the velocity of water flow and reduces its carrying capacity.

During the construction period, there was a lack of regulatory structures such as fall outlets, which were not provided in some minors and distributaries. As pointed out in a report of the water management authority, the absence of control devices at the canal outlets resulted in disparity in water discharges at different points. While at one outlet, the discharge was more than the design capacity, at another, often at the tail ends, it was much less.[3] The rubble cascade type or skin type falls were damaged, and not renovated. At many places, says Ajit Pradhan, junior engineer in the Gudbhaga irrigation sub-division, controlling shutters in the water courses were missing and the flow of water was regulated with straw and boulders.[4]

During the AIBP (Accelerated Irrigation Benefit Programme) renovation work and recent renovation work, falls, siphons, outlets, gates for distributaries and concrete lining were constructed on the main canal, distributaries and minors. As a result, the situation improved after 2001. However, a lot of effort and work is required to bring irrigation water equitably up to the tail ends.

In most villages, land consolidation is not implemented properly (Mearns and Sinha, 1999).[5] Farmers still cultivate small plots of land which have restricted construction of CADA (Command Area Development Authority) channels (field channels) for management of irrigation water at the field level. The dominance of the flood irrigation

[1] *Warabandi*, as it has been institutionalised in Pakistan, is a rotational method for distribution of irrigation water, with fixed time allocations based on the size of landholdings of individual water users within a watercourse command area. It presupposes an overall shortage of the water supply. The primary objective of the method is to distribute this restricted supply in an equitable manner over a large command area; http://wiki.answers.com/Q/What_is_warabandi_system#ixzz1tXl9XJcy

[2] http://kantikumar.com/research/hirakud/part1-poor-distribution-system/

[3] Ibid

[4] Ibid

[5] Of the 134 villages in which the operation had been completed and *pattas* distributed, however, landowners in 47 villages (35%) have refused to take possession of the new holdings, since they are unwilling to undertake the large-scale exchange of plots that would be required to effect the consolidation process. Some of these villages are located at the tail-end of the Hirakud irrigation system where there is considerable fluctuation in water availability. It appears that landowners do not have confidence in the way the proposals were prepared in practice, and fear that the method adopted has not adequately taken into account the variations in land quality. It is suggested by informed observers that such conditions, accounting for much of the local resistance to land consolidation, are typical of the hilly tracts of western Odisha.

system is resulting in an increase in the salinity, reduction in productivity of low lands, and more investment in labour for cultivation.

Waterlogging

In response to local geography, farmlands were traditionally developed according to the water availability. The farmlands on a topographical sequence from up to low lands with an ascending order of fertility are known as *At* (Ridges), *Mal* (slopes), *Berna* (dales) and *Bahal* (low lands) lands locally[6] (Mishra, 1985). Due to the inefficient canal system, more seepage and leakage, there is surplus water in the lower *Bahal* lands, while there is shortage of water in the upper *At* lands. In this region, there is a hard rock pan of granite in the subsoil, because of which seepage in the uplands surfaces in the low lands.

A survey carried out by the state Soil Conservation Directorate in 1975 found that about 8% of the culturable command area under the Hirakud project suffered from dampness caused by waterlogging. The Central Ground Water Board has reported that waterlogging conditions (depth to water table less than 2 m) existed in an area of 174 sq km during the pre-monsoon period in May 1994, and that it was 1494 sq km during the post-monsoon period in November 1994 in the Hirakud command. Topographic profile, unlined canals, over irrigation and two-season paddy cultivation during Kharif followed by Rabi are mainly responsible for the waterlogging conditions in the command area. Depth to water table varied from 0.8 to 9.7 m bgl (below ground level) during the pre-monsoon period, and 0.3 to 4.03 m bgl during the post-monsoon period. During the month of August, a major part of the command area remains within a depth to water level range of 0 to 2 m bgl.

Due to waterlogging, the productivity of the *Bahal* lands is reducing. These lands require more economic and labour investments than other lands due to waterlogging. According to Dr. Sradhakar Supkar, an ex- Member of the State Legislative Assembly, at least 23% of the low-lying lands (*bahal* and *berna*) were affected by waterlogging during the Rabi season cultivation in.[7] In Bisalkhinda village of the Sason command, huge crop loss has been reported in the *Bahal* lands due to waterlogging. According to the Soil Testing Laboratory, Sambalpur, the soil from Dhankauda and Maneshwar blocks which get irrigation water from the Sason command is becoming more acidic. This is due to waterlogging and the excessive use of fertilisers. There is a lack of any drainage system from the *Bahal* lands. There has been no initiative to treat waterlogged areas in the region.

The *Bahal* lands in the region are identified as the most productive and fertile lands, but due to water logging, these lands are becoming low yield bearing lands day by day. During the rainy season, the canal water and rain water together cause more waterlogging in the *Bahal* lands, which makes it difficult for farmers to apply fertilisers and pesticides, and also to harvest the crop due to standing water in the fields. These lands are becoming more expensive to cultivate due to waterlogging. In the recent erratic rainfall of December 2011, the crop damage in *Bahal* lands was more than in the other lands.

[6] At the ridge crest are the uplands, and at the upper slopes the bunded and unbunded lands which are locally called '*Att*' and '*Mal*' respectively, which together constitute the high land. The valley bottom lands which constitute the lowlands are called '*Bahal*', and the lower valley side lands constituting the medium lands are called '*Berna*'.

[7] http://kantikumar.com/research/hirakud/part1-no-official-estimate/

CADA Channels and Irrigation Management

The Command Area Development Authority (CADA) is a centrally sponsored agency for the development of command area irrigation potential. It gets 60% of its funds from the central government, 30% from the state government, and the remaining 10% from farmers. The Sambalpur division has a regional office in Sambalpur city with an executive engineer as chief of the division. The CADA work started in the command area during 1971. The main responsibility of the agency is to construct field channels at the field level for proper utilisation of irrigation water after water courses, minors and sub-minors have been constructed. The second responsibility is to prepare drainage channels for water discharge from waterlogged areas.

The agency work suffered due to the lack of funds in the early years. The early infrastructure built by the agency in command areas was damaged within two to three years. The CADA was given Rs. 15,000 per hectare for one-time work, and Rs. 6,000 per hectare for maintaining the channels. These funds are not sufficient for cement concrete channels. In the field, they are working with Pani Panchayats for the construction of field channels. Due to the shortage of funds, cement concrete work can be taken up only on very small areas. The remaining channels are earthwork channels. The earthwork channels are damaged by farmers during Kharif cultivation when there is less demand for irrigation water. In Rabi when these channels are needed, they are no longer available. The irrigation water moves by flooding from one field to another.

Many villages did not accept land consolidation, and continue to cultivate their scattered smaller plots (Mearns and Sinha, 1999). Field channels are to be constructed according to the consolidation report, and in absence of its implementation, field channels often pass through the farmers' field (pre-consolidated plots which they continued to cultivate). This makes laying of field channels difficult and unacceptable to the farmers. Of late, CADA has started getting more funds for laying of field channels. The recent work of CADA is bringing good results in irrigation water management in some areas.

Traditional Water Bodies

Traditional water bodies such as Kata, Bandhs and Mundas have been the lifeline of villages in western Odisha. According to the Sambalpur gazetteer, in 1931 there were 12,282 tanks which were irrigating nearly 148,000 acres of land in undivided Sambalpur district. At present, these structures have either been silted up or encroached upon and converted to farmlands. The seepage water from the irrigation system flows directly into these water bodies through gravity flow, but there is a lack of drainage from these structures which contributes to waterlogging in the region. The potential of these water bodies to complement canal irrigation was not explored. The villagers do not think these structures can provide a second option for irrigation.

In most cases, Scheduled Caste (SC) and Scheduled Tribe (ST) farmers cultivate vegetables on the beds of these water bodies. They sell these vegetables in weekly markets in nearby villages and earn their livelihood. Vegetables are being cultivated on nearly 18 acres of land in Bad Kata of Mirgamunda village. This patch is providing livelihood for nearly 52 tribal families of Mirgamunda village. After the Panchayat Raj

system was introduced in the villages, these water bodies have become the property of village panchayats. In most cases, however, these structures have been abandoned due to lack of funds and village politics. The canal irrigation system does not incorporate these structures to increase the irrigation potential.

Cropping Pattern and Agriculture

Before the irrigation system in the region, the cropping pattern was different. According to the Sambalpur Gazetteer, crop rotation was practiced on different types of land on the basis of water availability. However, paddy was the major crop grown in the region. There were other major crops such as pulses, wheat, groundnut, maize, jute, sugarcane and potato. According to the Dewar settlement report (1906), paddy became a major economic crop due to the Bengal - Nagpur railway line which came into operation in 1890. The price of paddy went up due to exports from the district. As a result, other economic crops such as sugarcane were replaced by paddy. A number of tanks were constructed in the region for securing paddy crop when there is less rain (Senapati and Mahanti, 1971). According to K. Supkar, retired engineer from the Hirakud administration, the area under paddy cultivation was more than 85% before Hirakud irrigation.

The Hirakud irrigation water started to flow in the Sason canal from July 1956. However, most of the irrigation water remained unutilised up to 1965, when the High Yielding Varieties (HYV) programme was initiated in undivided Sambalpur district with few improved varieties of paddy. The field demonstrations, use of chemical fertilisers and pesticides increased paddy yield to 18.12 quintal/acre, as compared to 11.16 quintals/acre for improved paddy. The area under high yielding paddy progressively increased from 12,058 acres in 1965-66 to 126,599 acres in 1969-70. Though, the area under other crops also increased rapidly, this area was very small compared to that under paddy. By 1969, the entire Rabi irrigation potential was utilised, and the double-cropped area increased from 87,000 acres in 1961-62 to 226,000 acres in 1969-70. The double cropped area in Rabi had paddy as the main crop (Senapati and Mahanti, 1971).

At present, the villages cultivate paddy on nearly 90% of the total sown area. The irrigated area in the Sason command is fully under paddy cultivation. As of 2007, the coverage under Rabi was 67% of the command area, when 50% had been anticipated in the original design, and 95% of the area was covered by HYV of paddy, which was to be limited to only 70% of the Rabi area. Paddy was grown in 158% of Culturable Command Area (CCA) in the Kharif and Rabi seasons; the corresponding area according to the plan was 103% (GoO, 2007).

The cultivation is done through transplanting, which requires more water than broadcasting paddy. Puja, Swarna, 1001 and 1010 are the ruling HYV paddy varieties. These varieties require more water during the flowering period. During the recent erratic rainfall, the Swarna HYV variety faced major crop loss in the region. Puja and Swarna are known for bumper production, but are vulnerable to pest attacks, and unable to sustain during water shortages. Surendra, 1001 and 1010 are less vulnerable to pest attacks and able to sustain during water shortages. However, their yields are less than those of the Puja and Swarna varieties.

Cultivation of other medium and low duty crops is not possible in the command region due to the flood system of irrigation. The farmers are bound to cultivate paddy due to a lack of field level irrigation water management. The existing market system also encourages paddy, as provisions of MSP (minimum support price) and a procurement network of rice mills and Food Corporation of India (FCI) are available locally for paddy, while these are absent for other crops. There is less scope for marketing and transport facilities for other agricultural products. Some farmers from Talab village tried to cultivate potatoes and ginger as other crops, but did not get marketing facilities for selling them.

The extension services in the region have their own limitations. There is one Village Level Worker (VLW) of the agriculture department for two to three gram panchayats. Burdened with different responsibilities including that of distributing compensation for crop loss due to drought and erratic rainfall, they hardly find any time to provide proper extension services. The Assistant Agriculture Officer (AAO) is unable to introduce crop diversification in the area due to the existing irrigation system. The agenda notes of the Deputy Director of Agriculture (DDA) for Kharif and Rabi crop planning of Sambalpur district reflect the focus on paddy, with mainly paddy varieties being mentioned as crops for the Sason command area.

The introduction of HYV paddy experiments in the command region in 1963 resulted in basic changes in agricultural costs. Agricultural inputs such as chemical fertilisers, farm equipment and pesticides were provided free or at subsidised cost by the government. As a result, traditional farming practices in the command area were abandoned. The use of chemical fertilisers and pesticides trapped farmers in the vicious circle of high input-oriented agriculture. The productivity of land decreased with chemicals and waterlogging, demanding more application of chemical fertilisers to increase agricultural production and so on. Subsidy cuts and reduction in state support for agricultural production resulted in an increase in costs of agricultural inputs such as chemical fertilisers and pesticides. At present, farmers are unable to afford agricultural implements and machinery due to increased costs. Production of paddy is no longer economical. Most of the times, the input expenses exceed the returns from selling paddy. There is a substantial increase in labour costs in recent years. Most tenants and sharecroppers are under pressure to leave agriculture. Crop loss due to drought and erratic rainfall is resulting in more economic losses for farmers as there is little compensation provided by the government.

Recently, the winter paddy production was reduced to half due to heat stress between periods of flowering. Pest attacks were more intense due to hot weather conditions in January and February. Industrial pollution also affected the production. The farmers said that they had to continuously spray pesticides, and apply lots of chemical fertilisers for ensuring a good yield of paddy. During the winter rainfall of 2011, the irrigated area faced a large amount of crop loss. As a result, a number of tenants are thinking of giving up tenancy due to extensive losses.

Irrigation Cess

An irrigation cess is collected according to a provision of the 1961 Irrigation Act of the state government. The cess is collected by the Revenue Department. According to the

Irrigation Act of 1961, the Hirakud command area comes under the first class irrigation category. The power to decide the irrigation cess rests with the Water Resources Department of the state government. According to the state water policy, the cost of operation and maintenance (O&M) should be fully recovered from beneficiaries. The Water Resources Department had formed a Water Rates and Cost Recovery Committee to fix and review water cess. This committee recommends water charges to the Water Resources Board. The Kharif cess falls under compulsory water cess collection, as the Irrigation Department owns all available surface water in the entire state.

The irrigation cess in the early period was nominal; the bulk of the cost of operation and maintenance was contributed by the state government. After the initiation of sectoral reforms in the water sector, the irrigation cess increased substantially. The State Water Policy of 1994 had prescribed that the operation and maintenance cost of the irrigation water supply services should be recovered.

Table 7.1: Changes in Kharif irrigation cess from 1981-82 to 2002-03 (WRD, 2010)

Sl. No.	Class of irrigation	Depth of water supply in inches	Irrigation rates for flow irrigation (Rs. per hectare)		
			1981-82	1998-99	2002-03
1	Class-I	28	39.54	100.00	250.00
2	Class-II	23	29.65	75.00	188.00
3	Class-III	18	19.77	50.00	125.00
4	Class-IV	9	9.88	25.00	63.00

The Rabi irrigation cess is not according to the inches of water supply per hectare, but according to the crop cultivated by the farmer. The Rabi cess collection in the Hirakud command region is mainly based on paddy as it is the major crop, with a coverage of more than 80% of the command area. In terms of area coverage, paddy is followed by vegetables and sugarcane.

Table 7.2 : Changes in Rabi irrigation cess from 1981-82 to 2002-03 (WRD, 2010)

Sl. No.	Class of irrigation	Irrigation rates for flow irrigation (Rs. per hectare)		
		1981-82	1998-99	2002-03
1.	Dalua (Paddy)	88.96	225.00	450.00
2.	Vegetables	44.48	115.00	230.00
3.	Sugarcane	100.08	250.00	500.00

The irrigation cess in 1998-99 increased by two to three times compared to the 1981-82 cess. Along similar lines, the cess in 2002-03 again increased to more than twice that in 1998-99.

During the commissioning of the irrigation system in the command area of the Hirakud reservoir, most of the village lands were under different uses such as pasture, village forest and barren land. Most parts of the command were having uplands which were not included in the command area. After commencement of irrigation in the command area, these lands and lands outside the command area were developed by farmers to get irrigation water through gravity flow. This resulted in an increase in the command area. There is an absence of any regulation from the Water Resources Department to regularise this increased command area. The irrigation cess is collected by the

Revenue Department; hence it can collect revenue from such command areas. There are farmers who are paying cess for the operation and maintenance of the irrigation system, though their farms officially do not fall in the command. Similarly, there are farmers who are paying cess for lands which are officially part of the command, but hardly get any irrigation water because of their location (viz. in the tail end) or land use change.

The Paddy Distress Movement is active in the command area of the Hirakud reservoir. The Regulatory Market Committees (RMC) which regulate farm produce markets in the command area made it compulsory for farmers to deposit the irrigation cess, without which farm produce would not be purchased in their markets. Farmers are forced to pay the irrigation cess at any cost to sell their produce in the markets. The anger of the farmers of the Paddy Distress Movement became more intense in December 2010, when local newspapers reported that the industries withdrawing water from the Hirakud reservoir are not paying the cess regularly. Farmers from the command area started to question the water resources department on this issue.

Land Revenue, Consolidation, Conversion

Land reforms and land ceiling did not change the land ownership pattern in the command area. To this day, there are a number of landlords in the command area who continue to own big chunks of land through *benami* and false records. Most of the land is owned by upper-caste people. This skewed land ownership has resulted in a practice of unregistered sharecropping and tenancy in the command area. The land consolidation of 1988 could not be implemented till date due to the resistance of farmers. The lack of land consolidation is affecting the irrigation management in the command area.

The command area is not plain, but has sharp slopes. The irrigation system has been designed for gravity flow. Initially, most uplands, pastures, village forests, barren land and government land did not fall within the command area.

With an increase in the cropping intensity, farmers stated to convert barren uplands and non-farm lands into cultivated lands. Such land conversion in the head reach was very high, which increased the ayacut areas in the head reach. As a result, the demand for irrigation water in the head reach increased, and there was a lack of irrigation water supply in the tail region.

Marketing System

According to section 2 (i) of the Orissa Agriculture Produce Markets Act, 1956, there was a provision for the marketing of 51 agricultural commodities in market areas. Though the market system for paddy is better than that for other crops, farmers often found it difficult to sell their paddy on the basis of MSP in the regulated market system. There were active movements against paddy distress sale in western Odisha. Even now, farmers are exploited by rice mill owners who manage to buy paddy without market regulations at prices lower than the MSP. In every district, there is a Regulatory Market Committee (RMC) which is expected to provide facilities for

marketing, weighing, farmers' meetings, storage, etc. These facilities are not available in districts of western Odisha. Most of the times, markets for purchasing rice from farmers are established on open grounds, and the farmers are forced to wait for their chance to sell their rice. Frustrated farmers often end up selling paddy directly to the mill owner at a lower rate than the MSP.

The paddy production fell sharply in 2003 due to the drought situation all over Odisha. Farmers from the command area thought that they would get a higher price for their paddy. However, there was no price rise. Farmers felt that there were some irregularities related to these issues. The market system was captured by rice mill owners, and most farmers sold their paddy directly to the mill owners at lower prices. There were additional deductions supposedly on account of moisture content and the presence of other inert materials. Farmers from Sambalpur district came together on this issue. They demanded *Mandis* (markets) to be operationalised, and that farmers would sell their paddy at Regulatory Market Committees (RMC) markets. This demand forced the state government to start the market system under the RMCs. The selling of paddy at lower rates was mainly due to malpractice in the calculation of moisture content. Farmers demanded that the moisture content should be calculated exactly through improved instruments. The introduction of a market system and the regulation of paddy selling resulted in an increase in the paddy sale price. The paddy distress movement was at its peak from 2002 to 2005. Due to this, the farmers in the Hirakud command were well organised.

At present, the paddy distress movement has a well organised and active network in the command area of the Hirakud reservoir. Farmers from Sambalpur district are now in market committees, and are participating in the decision making process of the agricultural market system. The Sambalpur Krushak Sanghatan, a major farmers' union, is known for the paddy distress movement in Sambalpur district. During the industry vs agriculture water conflict, these movements anchored the protests.

Farmer Suicides

Farmer suicides began to be reported in western Odisha from 2005, when one Andhra farmer allegedly committed suicide by setting himself on fire in front of the District Collector's office. In recent periods, farmer suicides are on the rise. According to Amitabh Patra, an independent activist from the region, there were 29 cases of farmer suicides in 2001-11. The state government has neither provided financial relief nor any other assistance to the families of farmers who have committed suicide. The Red Cross society in the state immediately provides Rs. 10,000 as assistance for the cremation.

The reasons for farmer suicides here are the same as those in the rest of the country. However, unlike states like Maharashtra and Andhra Pradesh where farmers are taking their own lives chiefly due to the burden of debt, in western Odisha, farmer suicides are occurring mainly due to crop loss and the lack of compensation. Most reported cases of farmer suicides from Bargarh and Sambalpur districts are from the irrigated area of the Hirakud dam command area. Irrigation facilities based on gravity flow, an inefficient water delivery system, paddy as a mono-crop, the excessive use of fertilisers and pesticides, waterlogging and the lack of a proper marketing system are

all making agriculture more unsustainable and economically less feasible. Farmers are forced to grow only paddy for which a Minimum Support Price (MSP) is assured by the government. In search of good economic returns and bumper crops, farmers are inclined to use fertilisers and pesticides in an intensive manner, which requires more money, thus forcing them to take loans from outsiders.

Industrial Pollution and Crop Loss

Farmers from the peripheral region of Hindustan Aluminum Company (HINDALCO) experienced crop loss due to fluoride contamination and air pollution in December 2007. This was the first time that the leaves of crops and trees got burnt. Paddy at the transplantation and flowering stages was destroyed due to air pollution and fluoride contamination. The company was forced to give compensation to the affected farmers.

Once again in 2011, HINDALCO's pollution resulted in crop loss in Mahamadpur Village of Dhankauda block of Sambalpur district on 13th September, and Bujatal village on 24th September, due to fluoride contamination. Farmers agitated due to the crop loss. As a result, the district administrations asked the state Pollution Control Board to submit a report on this issue. According to farmer leaders, there are some contradictions in the report which serve the interest of HINDALCO companies. Due to this, the affected farmers have not received any compensation until now.

Water User Association/Pani Panchayats

The Pani Panchayats are Water Users Associations (WUA) in the command. They were formed according to the Pani Panchayats Act, 2002 and Pani Panchayats Rules, 2003. Pani Panchayats are managing irrigation water in their respective units. The management body is elected by farmers with farms in the respective unit. The representative body elects the President, Secretary and Treasurer. Pani Panchayats are funded by the state government. Funds are allocated annually for maintaining the irrigation system of the respective units. When there are two to three Pani Panchayats in a single distributary, a distributary level committee is formed for managing the irrigation water at the distributary level. Four section-wise apex bodies of Pani Panchayats have been formed in the command area. At present, the formation of the Sason command level apex body of Pani Panchayats is yet to be formed for this term.

Though they are responsible for implementing irrigation management and proper distribution, many Pani Panchayats are not receiving annual operation and maintenance funds for the last seven years. They had received operation and maintenance funds for the first year. Since then, most of them have not received funds. In absence of adequate government support, office bearers of Pani Panchayats are facing the wrath of farmers, as they are unable to manage the irrigation system effectively. The canal administration is also not consulting them in deciding the quantity of water discharge and duration of flow in the main canal. According to the Pani Panchayats Act, they are responsible for formulating estimates with the help of the government officer responsible for conducting renovation work at distributary, minor, sub-minor, and field channel level. According to the Pani Panchayats, they are not involved in the renovation work in their units related to the irrigation system. The irrigation administration makes estimates on its own and carries out repairs without

any consultation with the Pani Panchayats. There is a need for regular meetings of all Pani Panchayats for collective decision making, which is not taking place.

At present, CADA is working with some Pani Panchayats for construction of field channels, with good results in delivering irrigation water up to the tail end in some units. The unit or apex body committees of the Pani Panchayats lack decision making powers. For any official procedure, the Pani Panchayats require the approval of the irrigation administration. Though they are entrusted with responsibilities for equitable distribution of irrigation water up to the tail end, they are not appropriately empowered to fulfill these responsibilities.

In spite of many difficulties, the Pani Panchayats are trying to manage irrigation equitably. During periods of high demand, they coordinate with the canal administration and convince upstream farmers to leave water for the tail areas. There are a number of conflicts related to irrigation water distribution, which Pani Panchayats are working to resolve at the village level. The Mudhenpali Pani Panchayat in the upper Huma section solved irrigation problems up to a large extent through collective decisions and rotation of irrigation water supply. The Pani Panchayat brings all farmers together and formulates a timetable to share water in the fields. Due to this, the water reaches the tail ends, and a large area is irrigated with a small amount of water.

Participation from farmers is crucial for participatory irrigation management by Pani Panchayats. The act and water policy of the state government lays emphasis on participatory irrigation management, through handing over the irrigation system management, cess collection, operation and maintenance to the water users; however, in practice, there is a lack of transfer of rights and responsibilities to water users at the local level (Mahapatra, 2006).

In the command area of the Hirakud reservoir, the participation of women, marginal farmers and land labourers is less (Mahapatra, 2006). The participation of women is less due to the patriarchal nature of society, and the concentration of decision making in the hands of men. Most landless labourers and marginal farmers are tribals and Dalits, and caste and ethnic discrimination also affects participation in the irrigation management in the command area. The Pani Panchayat Act ensures the participation of water users who have their land in the Pani Panchayat unit. However, landless farmers and labourers, tenants and sharecroppers who are also dependent on the irrigation water are deprived of participation in decision making about irrigation water management in the command area. Women constitute a major workforce in agriculture and water management at the farm level, but the lack of women's participation in decision making deprives them of their right to manage irrigation water.

Due to a lack of proper training and orientation, most Pani Panchayats are captured by local elites. Local contractors and influential persons occupy the main positions in the Pani Panchayats. Democratic decision gets sidelined due to the lack of participation from all water users in the Pani Panchayats.

Chapter 8

Policy Changes

8

This chapter presents the policy changes in the state towards industrialisation and reforms driven by LPG (Liberalisation, Privatisation and Globalisation) since the nineties, and explains how this shift has affected the use of water and natural resources in the region. Following a brief introduction to macro-policy contexts, the chapter discusses the process of water sector reform in the state since the nineties, analyses changes in policy, and locates Hirakud and the stakeholders involved in the conflict within the larger context of policy changes and sectoral reforms.

Policy Shifts in Odisha

In the last decade of the twentieth century, LPG became the norm for state policies. In Odisha's quest for faster development, its rich natural resources[1] including water became the basis for initiating sectoral and institutional reforms[2], and inviting external investment for rapid industrialisation[3]. The state's development strategy has focussed on macro-level promotion of mining, power and heavy industries. Public investments have been substantial in the areas of developing water resource facilities.[4] This pitted the environment against development, equity against growth[5], and socio-cultural value systems against the neo-liberal quest for prosperity.[6]

[1] The Government of Odisha has been taking proactive measures to attract investments by creating the concept of 'Team Odisha' that encompasses the broad institutional framework of the government which is engaged in industrial facilitation and investment promotion in all key areas of economic growth. The 'Odisha Perspective' page of its website mentions that "Odisha has vast reservoirs of natural resources to spur industrial growth and development. Its fertile land, water resources, mineral wealth, long coastline and forest resources are great assets." http://www.teamorissa.org/adv_orissa.asp

[2] For example, the process of power sector reforms in Odisha, which has been underway since 1996. The Odisha model of 'reforms', under the prescription, guidance and supervision of the World Bank, has since been adopted by virtually every reforming state in the country. (http://www.frontlineonnet.com/fl1910/19100420.htm) Since 1996-97, the Department of Public Enterprises has been overseeing the Orissa Public Enterprise Reform Programme (http://www.orissa.gov.in/publicenterprises/programmes.htm). A task force on governance and civil service reform had been constituted by the state since October 2000. DFID and World Bank have been supporting the fiscal and expenditure policy reform in the state articulated in the white paper on public expenditure management and approved by the cabinet (http://orissa.gov.in/ga/ARCell/OMGI/programm%20document.pdf). Public-Private Partnership (PPP) has emerged as one of the important strategies for health sector reforms in Odisha.(http://203.193.146.66/hfw/PDF/ppp-health.pdf)

[3] Government of Odisha states in its industrial policy that large industrial units are essential for economic growth in the state. The Government of Orissa IPR 2001 draft mentions the following objective: "Make Orissa one of the most preferred destinations for industrial development... and to attract investment of rupees 100,000 crores by the year 2005". Toward this goal, the policy highlights six industrial areas, the first among them being mineral based industries. (Vasundhara, 2005)

[4] Vasundhara, 2005

[5] Large scale planned development in Odisha has required the acquisition of land, primarily agricultural land, over the last five decades. Projects such as the Rourkela steel plant, Hirakud, Upper Kolab, Indrâvati and Subarnarekha multipurpose dams, Hindustan Aeronautics, Talcher thermal power station, Balimela dam, and the National Aluminum Company were constructed in resource rich areas inhabited by adivasi and poor rural communities. While these projects have greatly benefitted the state's economy, they have also led to the loss of livelihood of poor communities from agriculture and forests, and the displacement of marginalised peoples from their lands. (Vasundhara, 2005)

[6] Choudhury and Satapathy, 2010

Industrial Policy and Implications for Hirakud

The first industrial policy formulated by the Government of Odisha in August 1980 reflected an integrated approach to exploring the opportunities lying untapped in the industrial sector. However, the shift in the direction and focus of the state government gained momentum in the successive policies of 1992, 1996 and 2001. All these policies had been framed after the adoption of the policy of economic liberalisation at the centre, and envisaged higher private investment in large industries and the mining sector, growth of infrastructure, and expansion of employment opportunities, leading to economic growth (Vasundhara, 2005). The Industrial Policy Resolution, 2007 aims to create a business climate conducive to accelerating investment in industry and infrastructure projects, deregulating the business environment, implementing and operationalising a single window mechanism for industrial clearances, and ensuring a balanced utilisation of natural resources for sustainable development. The first two key thrust areas identified include downstream industries in the steel, aluminum and petrochemical sectors and mineral processing and value addition.

The key objectives of the Orissa Public Private Partnership Policy 2007 are leveraging state and central government funds, supporting private investment, and creating an environment conducive to utilising the efficiencies of the private sector, its flexibility and capacity to innovate, in order to provide better infrastructure and services at an optimal cost.

After 1991, industrialisation began in the peripheral area around the Hirakud reservoir in Sambalpur and Jharsuguda districts. Mineral based industries started colonising the region due to the availability of water from the reservoir, and coal from Mahanadi Coalfields located in the adjacent Ib river valley. Initially, sponge iron units were more prominent. Thermal power based heavy industries with captive and independent power plants started to come up after 1991. Now, there are alumina, thermal power, sponge iron, and steel producing industries. Every industrial unit in the region has its own captive power plant for internal consumption. Thermal power generation, which requires more water, led to heavy water intake from the reservoir. Mahanadi Coalfields Limited is carrying out open cast mining in the Ib river valley. This huge tract of coalfields is between the Mahanadi river and Ib. There are major coal deposits of this coalfield on the peripheral area on the left bank of the Hirakud reservoir.

The industrial intake from the reservoir began rapidly after 2004, due to new mega industrial units including Vedanta Alumina and Bhushan Steel and Powers, which began functioning that year. In 2005, the irrigation water supply to the mouth of the Sason canal from the reservoir was cut off. As a result, agriculture in the command region faced a serious threat. Industrial water intake from the reservoir was one of the reasons for the lack of water in the Sason canal, which led to a conflict between agriculture and industry.

Water Policies and Sectoral Reforms

The water sector reforms began in Odisha after 1991. After the visit of the World Bank mission in 1993, the State Water Resources Department adopted a resolution for the formation of a multi-sectoral Water Resources Development Board (WRDB), chaired by the Chief Secretary of the state with 10 Principal Secretaries as members, as a first step towards adopting IWRM (Integrated Water Resources Management). This board

was formulated to advice the Water Resources Department on intersectoral water allocation between various sectors and the management. It was formed to guide the water planning directorate about water planning and allocation.

On the basis of the National Water Policy 1987, the state government formulated the first state water policy in 1994, which underscores the need for a coordinated approach towards the development of water resources in the state. Administrative measures were adopted to bring all subjects related to water under one umbrella. In 1994, the Irrigation Department was restructured as the Water Resources Department, which became the nodal department for all matters concerning the state's water resources.[7]

Two objectives of the Water Policy, 1994, are worth mentioning. While objective three mentions judicious allocation of water resources to different sectors, with drinking water occupying the top priority in order to satisfy this basic need of people, its fifth objective calls for the provision of adequate water for drinking and industrial use.[8] Adopted in the early LPG influenced reform era, the policy has been critiqued as having been influenced by the World Bank.[9] The main objective of this policy was to undertake spiral studies in river basins and formulate a state water plan.

Table 8.1: Policies and legislation in Odisha related to water

Bengal Drainage Act, 1880
Bengal Embankment Act, 1882
Bengal Ferries Act, 1885
Inter State Water Disputes Act, 1956
Orissa Irrigation Act, 1959 and Orissa Irrigation Rules, 1967 (Amendment in 1999)
Canal and Navigation Act, 1864
River Board Act, 1956
State Water Policy, 1994
The Orissa Pani Panchayat Act and Rule, 2002
State Water Plan, 2004
Pani Panchayat Act, 2005
The State Water Policy, 2007

The Water Resources Department implemented the Odisha Water Resources Consolidation Project (OWRCP) from 1996 to 2004, with the technical and financial assistance of the World Bank. This project was designed to implement Integrated Water Resources Management (IWRM) in the state. Under this project, there were three spiral studies conducted in the main river basins of the state. These studies were carried out to understand existing river basin water use and upcoming water uses. This project also brought reforms in the water sector management of the state (1st IWRM spiral), through the introduction of the Odisha Water Planning Organisation (OWPO), amendment of the Irrigation Act 959 and enactment of the Pani Panchayat Act, 2005. Following this, the Asian Development Bank (ADB) expressed interest in providing technical assistance for the ongoing water sector reforms.

In 2003, the state government came up with a draft water policy based on the National Water Policy 2002, which reiterates the following statement: "The ultimate goal of the state water policy is to develop the State Water Plan, a blueprint of water resource development of the state". There was an absence of any regional, geographic and socio-cultural aspects in this draft.[10]

[7] GoO, 2009
[8] Dash, 2006
[9] Padhi, 2009
[10] Padhi, 2009

Based on the spiral studies, the state government brought out a comprehensive State Water Plan (SWP) in 2005. This plan was formulated by the Odisha Water Planning Organisation (OWPO). The SWP analyses present water uses among different sectors and demands. It was the product of basin level spiral studies conducted by the Water Resources Department under OWRCP. It also proposed water use changes and predicted future sectoral demands up to 2051. The key priorities of the SWP included (i) reviving investments in irrigation, including improved efficiency of existing systems, and creating new systems; (ii) ensuring safe drinking water and waste disposal in rural and urban areas, by giving financial autonomy to their management bodies; (iii) reducing the gaps between environmental regulations and practices; and (iv) enhancing Operation and Management (O & M) sustainability by levying reasonable water charges. Overall, the plans provided a solid initial basis from which to pursue integrated water sector planning and investment.[11] The formulation of the state water plan and its implementation was part of the second IWRM spiral in Odisha. With the completion of the World Bank-funded Orissa Water Resources Consolidation Project in late 2004, the reform process lost momentum. The process slowed down because funds, stakeholder participation, capacity and ownership were lacking.[12] As a result, the SWP was put on hold, and the second IWRM spiral was aborted.[13]

The draft policy had already come out in 2002, but there was a delay in finalising it due to pending multilateral negotiations, and the revised policy was finally adopted and came into force in 2007.[14] The State Water Policy, 2007, accords the first priority to drinking water and domestic use (human and animal consumption), followed by ecology, irrigation, agriculture and other related activities including fisheries, hydropower, industries including agro-industries, navigation and other uses such as tourism.[15] According to this policy, river basins and respective watersheds will be the basic unit of planning, management and allocation of water resources of the state. The state government implemented the Odisha Integrated Irrigated Agriculture Water Management Investment Programme (OIIAMIP) in 2008 with the technical support of the Asian Development Bank (ADB).

The policy reconfirms the principles of participatory irrigation management (PIM), full recovery of O&M costs from users and IWRM, particularly by recognising the river basin as the basic unit for water planning and management. Consequently, the Odisha Water Resources Department has issued a resolution (No. 5788 dated 26th February 2007) that stipulates the composition and functions of the multidisciplinary river basin organisation (RBO)[16] for planning and monitoring all water related activities in the eleven river basins of Odisha.

This policy and institutional step forward coincided with ADB involvement in supporting the state water resource development agenda. The OIIAWMIP was launched in 2008 with the objectives of enhancing productivity, water use efficiency, sustainability of irrigated agriculture, and improving performance of irrigation service delivery and water resources management with empowered water users associations (WUAs) progressively taking over O&M roles. The programme includes a sector road map for policy and institutional changes prepared with the state of Odisha. This road map focusses on strengthening the capacity of the DOWR, improving the legal framework for participatory irrigation management, achieving sustainable O&M financing and irrigation management transfer to water users associations, and pursuing the IWRM reform agenda.[17]

[11] Cauchois, 2010

[12] Cauchois, 2010

[13] Cauchois, 2010

[14] Padhi, 2009

[15] GoO, 2007

[16] The structure of the RBO would be two-tiered with a Board and a Council. The Board was proposed to be a professional body with the responsibility to plan development of water resources in the basin. The Council was proposed to be a body of stakeholders to deliberate on action plans put up by the Board and accord necessary approval. The DOWR Chief Engineer and Basin Manager was to be a Member Secretary of the Council as well as the Board.

[17] Cauchois, 2010

The IWRM agenda for the state consists of (i) assessing and defining appropriate IWRM functions and institutional arrangements for setting up a State Water Regulatory Authority (ii) preparing multi-sector river basin plans while establishing participatory river basin organisations; and (iii) strengthening the database and decision support systems for the concerned river basins. The process will be guided by the State Water Resources Board with stakeholder participation.[18]

Civil Society Response[19] to State's IWRM Road Map

Civil society organisations have raised a number of issues in relation to the state's IWRM road map, some of which are as follows. Of the four principles of IWRM i.e. participation, gender mainstreaming, resource integration and water as an economic good, the last principle has overshadowed the entire document. It is premised on the economics of water as a resource, and takes no clear stand on 'economic good' vs 'social good' positions. Integration between water, agriculture, forest and other natural resources is absent. The report follows the same standard 'Reform Model' (TRIP) which is not grounded or evolved from local demands. The target constituency is not spelled out clearly. The IWRM road map is formulated on a scarcity scenario, and has ignored the fact that the state gets 1500 mm rainfall and many of the climate change projections have indicated wetter conditions. The report makes a messy analysis of river water quality. Budgetary deficit is not a problem as discussed in the report, because the water resources budget has been underspent for many years. The consultation process has not been inclusive. The focus is more on command area farmers, while farmers cultivating rainfed lands are ignored. Drinking water is also not discussed in the report.

The proposed Water Regulatory Authority and the operation and maintenance cost recovery system are not acceptable. The RBO will not solve the purpose as farmers may not be represented properly. The proposed RBO in the Baitarani looks top heavy with complete governmental control. The framework is not addressing the ongoing and emerging conflict around water. The engineering paradigm is still continuing to control water resources. Water is not only a hydrological unit, it is also a social and cultural unit; however, the socio-cultural aspect is completely ignored. The function of the RBO is confusing. There is no guideline for determining priority in water allocation, and how it will carry out its functions and to whom and how it will be accountable is also not clear. The proposed RBO is only a recommending authority with no decision making powers.

Legal Framework around Hirakud Inflow: Interstate Relations on Mahanadi Water Distribution

At the time of dam construction, there was no bipartite agreement between the governments of Odisha and Madhya Pradesh (MP). However, the issues concerning the interests of both states have since been discussed in various meetings.[20]

To discuss the sharing of water from the Ib River water diversion scheme, a meeting between officials of MP and Odisha was held at Pachmarhi on 15th June, 1973. The Government of Odisha was apprehensive that the summer flows in the Ib river would be reduced due to diversions in Madhya Pradesh. It was decided that the flow data as

[18] Cauchois, 2010

[19] Proceedings of multi-stakeholder consultation on 'IWRM road map of Odisha' on 5th February, 2011 at Red Cross Bhawan, Bhubaneswar, organised by the Odisha Water Forum and Odisha State Centre of the Forum

[20] Odisha State Water Plan, 2004, Department of Water Resources, Government of Odisha

maintained by Madhya Pradesh at the Ib weir site and by Odisha at Brajrajnagar and Sundergarh should be exchanged and studied. Utilisation of Mahanadi waters was discussed at length. It was explained that the Mahanadi was the lifeline of Chhattisgarh and drains the rice bowl of the state. The total culturable command in the Mahanadi basin in Madhya Pradesh (now Chhattisgarh) was more than 10 million acres, falling in important districts like Durg, Raipur, Bilaspur, Bastar and Raigarh. These districts comprise extensive areas which grow the finest qualities of paddy, and not only meet the requirements of the state but also export substantial quantities to the neighboring states.

In a meeting in 1976, Madhya Pradesh provided information about the master plan for the Mahanadi basin, which was in progress. MP was vitally interested in making optimum use of the waters for the thirsty lands of Chhattisgarh. Odisha feared that progressive development of consumptive use of Mahanadi waters upstream of Hirakud would seriously disturb the use and operation of the Hirakud Reservoir as originally envisaged.

According to the memorandum of agreement about interstate irrigation and power projects signed by the Chief Ministers of Odisha and Madhya Pradesh on 28th April, 1983, both states agreed that the Madhya Pradesh government would spare 25% of runoff of the Ib river from the catchment area of the Ib dam project. Odisha agreed to fix the Ib dam water level at reservoir level (RL) 272.50 m. In this meeting, it was also agreed to establish a Joint Control Board to review the progress of the survey, investigation, planning, execution and operation of the joint interstate irrigation and/or power project(s) from time to time, and to discuss and resolve any issues.

Legal Framework around R & R

Before independence, Odisha did not have a well-framed rehabilitation policy. The Land Acquisition Act of 1894, and Land Acquisition (Amendment) Act, 1984 (68 of 1984) only ensured compensation, not resettlement of the affected. In 1973, Orissa formulated a Resettlement and Rehabilitation (R & R) policy for those affected by the Rengali project. This was extended to cover the Upper Kolab and other medium irrigation projects. This policy was revised in 1977 to extend rehabilitation and resettlement to displaced persons and families, as well as to delineate eligibility and enumeration criteria, and outline facilities to be offered, i.e., land for land and other compensation measures. In 1990, further liberal revisions were made to the rehabilitation and resettlement policy. It offered greater possibilities for land allotment and cash compensation to the project affected. However, the policy did not allocate ethical and equitable standards in outlining the criteria for eligibility, the extent of land allotment, the scope of rehabilitation, house building assistance, maintenance allowance, or employment opportunities.[21]

In 1994, the Orissa Resettlement and Rehabilitation of Project Affected Persons Policy recognised project affected persons (PAP) as eligible for rehabilitation and resettlement. However, unless they were physically displaced, they were not considered to be displaced persons. The policy clarified definitions for the project-affected zone and affected villages in the case of water resource projects. It significantly redefined 'displaced family', and 'displaced person' or 'oustee', and articulated the need for constructing a baseline socio-economic survey. It also stated

[21] Vasundhara, 2005

the process and terms for the identification of resettlement and rehabilitation sites.

In 2006, in response to public and political pressure in the wake of the industrialisation drive in the state, Government of Odisha brought in the R & R Policy, 2006. The main objectives of this policy are to minimise displacement as far as possible, recognise the concerns of the affected communities, pay special attention to the needs of vulnerable sections like women, indigenous people, children, the physically challenged, etc., ensure livelihood and environmental sustainability through a participatory and transparent process, and also ensure proper implementation, monitoring, conflict resolution and grievance redressal through an appropriate mechanism.

During construction of the Hirakud dam, only the Land Acquisition Act of 1894 was in place, according to which displaced persons were only paid full compensation for lands and properties acquired from them. They were free to resettle themselves in a place of their choice, or opt to resettle in a government sponsored colony with privileges and facilities[22] organised by the Hirakud Land Organization (HLO). Considering the quantum of displacement, it was an uphill and complex task for the HLO, with complaints continuing to be received till half a century after the construction.[23] There are many displaced families who are yet to be compensated after 53 years of construction. Those settled in the 21 non-revenue villages in the peripheral areas of the reservoir between 630' to 632' RL[24] have been continuing to cultivate lands which do not belong to them. Surplus land owned by either Jharsuguda farm or the Water Resources Department was allotted to the displaced families. Though there is a provision under the Orissa Land Reform Act for settling land with possessors for more than 12 years, these lands have not yet been regularised in the tillers' names. Budi Anchal Sangram Parishad (Submerged Area Revolution Council), an organisation of the displaced villagers, has been protesting for their rights since then. Recently, in 2011, the State government has declared that it will carry out a comprehensive survey of villages falling between these two contours, and record the rights in favour of these villagers instead of Irrigation Department. It may be mentioned that under LARR (Draft National Land Acquisition and Rehabilitation and Resettlement) Bill, 2011, there is a provision for return of land to the original owner, if the land is not used in five years for the purpose for which it was acquired.

Legal Framework around Fishery

During the initial period of reservoir formation, there was an absence of commercial fishery. The fishery rights were transferred to the fisheries department of the state government in 1960. Most displaced families were settled on the periphery of the reservoir. In the absence of any other option to earn a livelihood, they started fishing inside the reservoir.

In 2004, a new reservoir fishing policy was developed by the state, which increased the leasing tariff and brought in provisions which made fishing by these communities difficult and highly unviable.

Legal Framework around Water Allocation

The Odisha Irrigation Act, 1962 noted that the all surface water available in the state

[22] In the latter case, reclaimed lands were distributed among them at a subsidised rate at Rs. 213 per acre, though the cost of reclamation was Rs. 500 per acre. There was no limit to the extent of land for allotment. House sites were given free. They were provided timber at subsidised rate, manure and fertilisers for free, paddy seed on loan, irrigation provisions, drinking water, school buildings, community centers, etc. Transport was also free to carry their movables. The Hirakud Land Organisation was in charge of the orderly removal of the families from the reservoir area to their chosen place of resettlement. (Dalua, 1993)

[23] Dalua, 1993

[24] The land which was acquired at level 632 feet RL but not used by the reservoir as the FRL was fixed at 630 feet.

is owned by the Water Resources Department (WRD) of the state government. The allocation of water to different sectors is decided by the Water Resources Department. Before the declaration of the first water policy in 1994, the state government announced the formation of the Water Resources Board for the allocation of water among different users. The Water Allocation Committee of the WRD suggested that the Water Resources Board allocate water to different industries.

The Odisha State Water Policy, 2007 has set priorities for water allocation with drinking water being the first, followed by environment, irrigation, and power, with industry being accorded the fifth priority.

Before 1991, water was allocated chiefly for irrigation, hydropower and drinking purposes. Following the opening up of the Indian economy in the post 1991 period, the demand for water for industrial development increased. The water sector reforms began in the state from 1991. Even the Water Resources Board was formed after 1991 to manage the allocation of water. In the same year, the state government reserved a portion of the water (0.350 Million Acre Feet - MAF)[25] from the Hirakud reservoir for industrial purposes, which is nearly 8% of the water available.

During the peak period of the water conflict in June 2006, the Hirakhand Nagarika Parishad, a senior citizens forum from Sambalpur, wrote to the President of India on issues related to industrial water use from the reservoir, pollution in the reservoir, and lack of irrigation water for farmers. In response, the Engineer in Chief of the Water Resources Department created an experts team[26] to look into the issue. The expert team[27] responded as follows:

1. Irrigation water from the Hirakud reservoir is provided to 155,882 ha of land in Kharif and 103,397 ha on average in Rabi. However, the design ayacut of the Hirakud command is 153,846 ha in Kharif and 76,923 ha in Rabi.

2. Water for industrial purposes is being supplied to five industries accounting to 0.022 Million Acre Feet (MAF)/year. The state government has earmarked 0.350 MAF water for industrial utilisation.

3. Reservoir operations are being implemented according to the priorities set by the state water policy.

4. Through analysis of records from 1967-68 to 2004-05, it is revealed that the water supply up to 0.350 MAF/year from the reservoir to industries will not hamper Kharif and Rabi irrigation in the command region.

5. Hydropower generation will be hampered in the non-monsoon period.

6. Industries around the Hirakud reservoir are degrading the environment. Some industries are discharging their untreated effluents in the catchment region, which finally flow into the reservoir.

7. The construction of an approach road to the intake well of Bhushan Power and Steel Ltd inside the reservoir dumped 91.00 Acre-feet of earth. M/S Shyam DRI Power Limited constructed a boundary wall which is unauthorised encroachment in the reservoir.

[25] Vide Lr. No. Irr-222-HKDW-6/90-40945 of WRD, GoO

[26] Vide Lr. No. WG-HKD-9/06-11305 dated 21.7.2006, Water Resources Department, Odisha

[27] This team visited Hirakud dam on 27th July, 2006. They discussed with representatives of the Hirakhand Nagarika Parishad and visited the Hirakud reservoir regions. From the memorandum and discussion with the Hirakhand Nagarika Parishad, the committee came to know that the people are concerned about the deteriorated environmental situation around the Hirakud reservoir, and apprehend a reduction in irrigation water supply due to the release of water to industries.

8. The water supply to industries will have an adverse impact on the direct irrigation as well as Delta irrigation Stage-1 and Stage-2.

The expert team was of the opinion that the irrigation potential of the Hirakud reservoir would not be affected due to a reduction of 0.350 MAF/year water for industrial purposes. However, there will be a reduction in power generation from the reservoir. At present, 1.1 m water per hectare is released for irrigation during the Rabi season. This can be reduced to 0.95 m per ha. The saved 15% of water could be utilised for power generation. The loss of hydropower generation due to industrial water intake should be compensated by industries.

Under pressure from the opposition and strong farmers' movement against industrial water allocation from the Hirakud reservoir, the state government announced the formation of a high-level technical committee[28] in July 2007, which recommended that:

- Water is *prima facie* available to support the industrial requirement up to 90% dependability, the quantum of water required for industrial use being a relatively smaller component. However, a detailed study is required for the projected water demand for the next 25 years for all sectors, and a plan for meeting the same.

- Irrigation projects being based on 75% dependability criteria, water available for other users is substantial.

- The irrigation use is far (at least about 20%) in excess of its optimal requirements. Command area development works and improvement of the water delivery systems are required to minimise losses and to make water available to tail end users. Proper water management practices and use of modern technologies can reduce the irrigation water requirement considerably.

- Waterlogging conditions are developing progressively due to the continued application of surface water for irrigation by flooding that makes it obligatory to deploy conjunctive use options in these areas. Crop diversification needs to be implemented to improve the productivity of the land.

- At the least, the Operation and Management expenditure shall be recovered by upward revision of the water charges for irrigation appropriately over a period of time. Maintenance of the water infrastructure is highly essential to maintain and operate the system efficiently.

- While giving permission to industries for drawing water from the reservoir, adequate safeguards are to be incorporated. Return flows are generally high in industrial use, which could be over 80%. Zero based approach needs to be implemented by suitable recycling of water. Industries shall have back up storage for at least fifteen days of its need, and desirably for a month. Any water returned back into the reservoir must meet water quality standards prescribed for the same. Pollution control board shall take steps for monitoring the water quality and implementation of environmental safeguards.

- Withdrawal of water now for industrial or other uses involves loss of power. Quantum assessment of the power loss shall be case by case and necessary

[28] Notification of Water Resources Department, Odisha, No. Irr- II-HKDW-11/07 – 19692/ WR Dated 22.06.07. The head of this committee was Mr. Jayseelan, retired chairman of the Central Water Commission. The committee assessed water availability in the Hirakud reservoir in the post-monsoon period, studied rainfall pattern and runoff into the reservoir, and also the water use from the reservoir.

recoveries shall be made from the industries against the water drawn from the reservoirs.

- Being the Golden Jubilee year, it would be worthwhile to commission a specific study on the overall evaluation of the performance of the Hirakud project, its socio-economic and environmental impacts. This will be very useful for the planning of future projects using the lessons learned, and to counter the projection of water resources development in an adverse manner or misinformation due to non-availability of such supporting information and success stories from actual projects in operation.

The Water Resources Department allocates water to different industries/commercial establishments as per the provisions of the Orissa Irrigation Act, 1959 and the Orissa Irrigation Rules, 1961 and amendments from time to time. Presently, water is being provided to industrial units/commercial establishments as per the recommendation of the Technical Committee known as the Water Allocation Committee. So far, water has been allocated to 61 industries and other organisations through the Water Allocation Committee (WAC). According to the 2005 State Water Plan, the proposed water demand for industrial purposes from the Mahanadi and Ib river will be 656,000 cubic m/day (239.44 Million Cubic Metre (MCM)/year) for generation of 8200 mega watt (MW) of thermal power.

The collection of water rate from both the agricultural and industrial sectors was earlier vested with the Revenue & Excise Department. Responsibility for the collection of industrial water rate from the industrial sector was transferred to the Water Resources Department.[29] In August 2010, the Orissa Irrigation Rules, 1961, were amended to hike the water tariff.[30] It was last revised in 1994. Several leading industrial houses have urged the government to reconsider the stiff rise of almost 750%, calling the move unjustified. They have asked for a white paper on the availability of water so that they can plan their projects accordingly, besides expediting the requisite clearances for the allocation of water.[31] They have also asked for water rates being made applicable only to the actual quantity of water used in the manufacturing process.

As per the government, a penalty to the tune of Rs. 2 crores was collected from 15 industries that were drawing water unauthorised from different rivers during 2009-10.[32] As of September 2011, some 11 industrial units owed the Odisha government a whopping sum of Rs. 150 crores in water bills.[33] In an affidavit filed before the Odisha High Court, the state government admitted that outstanding water dues are mounting due to a contradiction over the quantum of allotment and actual lifting of water from the reservoirs. The affidavit, however, was silent regarding the measures taken for the recovery of the water dues from the defaulting industries. It further maintained that since the state has a substantial amount of groundwater reserves, it allotted water generously for industrial purposes after meeting the demand from the agriculture sector and that for human consumption.

[29] Vide Revenue & Excise Department Notification dated 29th September, 1999 and 11th October, 1999 published in the Odisha Gazettes vide No. 1423 dated 30.09.1999 and No. 1466 dated 13th October, 1999. The Department of Water Resources has been collecting the water rate from industrial units/ commercial organisations w.e.f 1st April, 2000. http://www.dowrorissa.gov.in/WaterPricing/WatertoIndustries.pdf

[30] The tariff has two slabs - one for consumption up to 5 cusecs of water, the other for use exceeding this amount. The rate of water has been fixed according to the Chhattisgarh model. For use of less than 5 cusecs water by industries or for commercial purposes, the rate has been revised to ‘ 15, 500 up from ‘ 2000 for one million gallon from Government sources. Use of water from department sources has been enhanced to ‘ 19,000, up from ‘ 2500. For industries using more than 5 cusecs water, the rate from government sources for one million gallon has been revised to ‘ 20,500, up from ‘ 2000. From department sources, it will be ‘ 25,500, up from ‘ 2500. For the first time, the water rate will be charged for use in hydropower projects. The rate for production of 1 kW power by using water from government sources will be 4 paise, while from department sources it will be 5 paise.

[31] http://www.indiawaterreview.in/Story/News/industries-urge-orissa-to-reconsider-water-tariff-hike/134/1#.T6bAM9mxk3A

[32] http://expressbuzz.com/states/orissa/industries-drawing-less-water-than-allocated/188920.html

[33] http://articles.economictimes.indiatimes.com/2011-09-01/news/29953778_1_water-dues-water-bills-power-tariff

Vedanta Aluminium, Jharsuguda, one of the big industries using water from Hirakud, has not paid Rs. 10.94 crores of its bills since 2008, as per this affidavit of the state Water Resources Department. Vedanta had approval from the WRD to draw up to 10 million gallons per day from the Bheden river. Though the company got approval, no agreement was signed. As per Vedanta, earlier they were using water from a different source. The Odisha government had allotted 30 million gallons per day (mg/d) for Vedanta's captive power plant and 20 mg/d to the Jharsuguda unit from the Hirakud dam (54.9 cusecs as per the allotment of WRD[34], which translates to 35.48 million gallons per day).

According to the 2001 Industrial Policy, benefit is given to an industry for setting up operations in remote locations. A company can get a 25% rebate if it uses water from a regulated source, and a 50% rebate if it uses water from unregulated sources. Vedanta claims eligibility for a 50% rebate but the state government is unwilling to give it.

Legal Framework around Pollution

The Water (Prevention and Control of Pollution) Act, 1974 as amended in 1986, is the basic legal framework providing the preliminary institutional set up and regulatory measures for water pollution control in the country. It provides for a wide range of penalties, including fines and incarceration for non-compliance. It is complemented by two more pieces of legislation, the Water (Pollution Prevention and Control) Cess Act, 1977 and the Public Liability Insurance Act, 1991 (World Bank, 1995). The Odisha State Pollution Control Board (OSPCB) came into being with effect from 6th April, 1983 after the Odisha Legislative Assembly adopted the Water (Prevention and Control and Pollution) Act, 1974 which was amended in 1978, and the Air (Prevention and Control of Pollution) Act, 1981, and repealed the Orissa River (Pollution Prevention) Act, 1953.[35]

Under section 25 and 26 of the Water (Prevention and Control of Pollution) Act, 1974, consent for the establishment of an industrial unit is required. Essentially, it is a certificate of site clearance to be given by the State Pollution Control Board (SPCB) before establishment of the proposed new project. This is issued once in the life span of an industrial undertaking. The SPCB issues the certificate only after considering the impact of the proposed project on the specified environment.[36]

The Water Cess Act was enacted in 1977 (amended in 1988) for levy and collection of cess on water consumed by the industries and local bodies with a view to augment the financial resources of the Central and State Pollution Control Boards. The cess combines the features of resource tax and effluent tax (Mishra and Sahu, 2009). The water cess is collected by the state boards for the state governments and by the central board for the union territories, and credited to the consolidated fund of India.[37]

There are 15 large industries - aluminium and thermal power plants - at Hirakud, which discharge effluent into the Mahanadi directly. The total industrial effluent released into the Mahanadi at Sambalpur is 736 kilolitre per day (KLD). The sewage water of the Vedanta project bears the maximum level of fluoride, i.e. 6.5 mg per litre. The highly poisonous water of the Bheden and Kharkhari is not suitable for the

[34] http://www.dowrorissa.gov.in/WaterPricing/WatertoIndustries.pdf

[35] Mishra and Sahu, 2009

[36] Mishra and Sahu, 2009

[37] Mishra and Sahu, 2009

sustenance of fish any more, thus depriving many people of their livelihood. The polluted water from these streams directly flows into the reservoir and degrades the quality of water.

Thousands of acres of seedlings were damaged in the nursery during the floods in 2012, and farmers in the command area faced huge crop loss. The people were of the view that it happened due to water polluted with chemicals from the Hirakud reservoir that is used for cultivation activities in the Hirakud command area. A farmer from the Attabira village in the Hirakud direct command brought the matter to the notice of the Human Rights Commission. After receiving a letter from the Human Rights Commission, the Superintendent Engineer of the Hirakud Dam Project requested the Pollution Control Board to carry out tests on the reservoir water and ascertain if it contains anything hazardous for cultivation.

Legal Frameworks around Command Area Irrigation Management

The irrigation system in the command region of the reservoir was included in the High Yielding Variety (HYV) program of 1964 with a focus on rice. Reforms in the water sector and opening up of the Indian economy after 1991 brought new changes in water governance around the Hirakud reservoir. As part of the sectoral reforms in the water sector of the state, irrigation water management and maintenance was put in the hands of water users through the formation of water users association, known as Pani Panchayats in Odisha.

The state government enacted the Pani Panchayat Act and Rule in 2002. According to the Pani Panchayat Act, the Panchayats are responsible for formulating estimates with the help of the concerned government officer for conducting renovation works at the distributary, minor, sub-minor, and field channel levels. According to the Pani Panchayats, they are not involved in the renovation works related to the irrigation system in their units. The irrigation administration makes estimates on their own, without taking into consideration the consensus of the Pani Panchayats, and renovates the system. Pani Panchayats are given more responsibilities, but there is a lack of training, funds and decision making powers. In most places Pani Panchayats, are dominated by influential persons in villages, which leads to a lack of accessibility for women and the poor.

As per the Orissa Land Reforms Act, 1960 and the Orissa Land Reform Rules, 1965, the government has not been able to apply necessary reforms and ceiling limits in the command region. Even today, there are number of landlords in the command region, who continue to own big chunks of land through *benami* and false records. Most of the land is owned by upper caste people. This skewed land ownership has resulted in the practice of unregistered sharecropping and tenancy in the command region. The land consolidation of 1988 could not be implemented till date due to the resistance of farmers. The lack of land consolidation is affecting the irrigation management in the command region.

Chapter 9

Stakeholder Analysis

9

Any effort towards resolving conflict is incumbent upon an understanding of conflicts and their causes through conflict analysis, and an understanding of stakeholders through stakeholder analysis. With this objective, this chapter attempts to delineate and analyse the different groups which influence or are influenced by the use and abuse of water from the reservoir, focusing on the Sason canal command. The conflict between industries and agriculture first emerged around water allocation in the command area of the Sason canal. The area upstream of the Sason canal and the Ib River is heavily industrialised, which has multiplied the industrial demand for water from the reservoir manifold[1].

The farmers' unions and government bodies are unable to come together for working towards resolving the conflict due to a number of reasons. The dialogue process between the farmers' unions and government bodies is important in the present situation. Stakeholder analysis will help us to understand the power structure, the interest of stakeholders, and the interrelations between them.

Stakeholder Groups

Farmer Groups

Kultas, Brahmins, Aghariyas and Andhra farmers are the dominant cultivators in the Sason command. The *Kultas* are native Oriya cultivators, belonging to the dominant cultivating caste in the region. They cultivate all types of lands and are known for their hard work. The population of the *Aghariyas* is lower. They migrated from Chhattisgarh for agricultural purposes. They cultivate low lands and are known for their bumper production. *Brahmins,* though major landholders in the command area, mostly live in towns and cities, with only a few of them cultivating their own lands. A majority of them lease their lands to sharecroppers or tenants. Andhra farmers, mostly from the East Godavari districts, have immigrated to the Hirakud command area during the construction of the dam. They own huge patches of land, and lease out their lands to tenants in most cases. At present, they are holding a large chunk of lands in the region. They are concentrated around Sambalpur town and in the command area of the Sambalpur distributary. They produce bumper harvests through external-input intensive farming in line with the technology of the green revolution. They are known for extensive (many a times excessive) use of water, fertilisers and other agro-chemicals in the region. The tribal communities such as *Kisan, Oram* and *Bhuinya* are small cultivators. They mainly cultivate small patches of lands near streams, canal beds and village lands. Some of them are tenants or sharecroppers. However, most

[1] Jayseelan committee report, August 2007, Paragraph 4.4.2, http://www.dowrorissa.gov.in/NEWS/HirakudHLC/Report.pdf

scheduled tribes (ST) and scheduled caste (SC) people work as agricultural labourers, sometimes also as bonded labourers, locally known as '*Goti*'.

Big Farmers

The big farmers in the region include former *Gountia*[2] families and Andhra farmers, and belong to upper castes. Most of them lease their land to tenants or sharecroppers. A large number of small and marginal farmers have smaller landholdings, but are cultivating large area as tenants and sharecroppers. A majority of these small and marginal farmers are from Andhra Pradesh and *Kultha* communities.

The big farmers who reside in the villages or in Sambalpur are active in the farmers' unions. They have a strong influence in village and regional politics. Most of them have joined different political parties and are active in politics. The Pani Panchayats (Water Users Associations) are dominated by them. They can easily influence the decisions related to irrigation water at the village level. There are a number of instances where they have influenced the decisions related to irrigation water at the distributary, minor, and sub-minor level for their own profits.

The big farmers grow paddy which is the main cash crop in the Hirakud command. They use tractors, haulers, power tillers and other capital-intensive technologies for the cultivation of paddy. They use a lot of fertilisers and pesticides to increase production. They spend nearly Rs. 12,000 to 13000 per acre on paddy cultivation in one season. These big farmers bring labourers during the sowing and harvesting period from Bolangir district or adjacent districts of Chhattisgarh and pay them fixed amounts. Due to their bumper production of paddy, the farmers dominate the *mandis* (markets). Recently, they actively participated in agitations for increasing procurement rates through the *mandi* system, and for compensation due to crop loss in the Kharif season as a result of heavy rainfall.

These big farmers were found to be more concerned about industrial water allocation from the reservoir than other farmers. They attribute the water crisis that began in 2005 to industrial water allocation. They are against any industrial water allocation from the reservoir. Due to the continuous flood irrigation system, *bahal* (lower plains) lands, mainly owned by the big farmers, are facing waterlogging problems. The cost of labour and other expenses to cultivate these lands are increasing day by day. Farmers are now demanding the development of a water drainage system in *bahal* lands.

Small Farmers

The small farmers are mainly *Kultas*, while some are from the Andhra community. There are also few small farmers from Scheduled Tribes and Castes. These farmers cultivate their own lands and, on the basis of their capabilities, also cultivate other lands through tenancy or sharecropping. For credit, they are dependent on cooperative societies, and of late, on microfinance agencies and banks. Due to unregistered tenancy and sharecropping, and in the absence facilitating legal instruments, they are unable to avail cooperative society loans, subsidies, equipment, seeds, fertilisers and compensation for crop damage. The landowners prefer not to register tenancy or sharecropping arrangements due to the fear of losing land. They also change tenants

[2] *Gountias* are the intermediaries used under the colonial/ *Zamindari* land revenue collection system. They used to be responsible for collection of cess from tenants, to whom they would distribute land. As such, they were controlling the lands, and redistributing lands according to the cess paying experiences. Even after land reforms, in most western Odisha villages, the *Gountias* effectively control or own more than half of the farm lands.

and sharecroppers periodically to maintain their possession of land. The license card for selling the produced paddy remains with the land owner. In most cases, the compensation goes to the rich landowners, not to the poor sharecroppers or tenants who actually cultivate the land. The tenants and sharecroppers are forced to take loans from moneylenders or local traders to bear cultivation expenses. During the period of harvest, moneylenders make their tenants repay loans in the form of paddy. As a result, tenants are forced to sell their paddy at rates lower than the Minimum Support Price (MSP) to the traders. The land owners sell their paddy selling license to millers and traders. The small farmers are exploited by all powerful vested interests.

The small farmers have also been active in the farmers' union, and have aggressively participated in farmer agitations. Though they participate in politics, they face a lack of representation in the region. Most of them are Panchayat members, union secretaries and Pani Panchayat members at village levels. They also collectively influence canal administration and decisions related to irrigation water.

They too are concerned about industrial water allocation from the reservoir. They think that the lifting of excessive water from the reservoir through intake wells by industries will affect irrigation water supply in the canal. Their next concern is the irrigation system and infrastructure. They feel that nearly 40% of irrigation water is lost due to seepage and leakage. They are exerting pressure on the Pani Panchayat, canal administration and local administration to regulate irrigation. The farmers who have lands beyond cross bunds are in direct confrontation with the canal administration as well as head reach farmers about allowing water to reach the tail ends of distributaries. Small farmers are also more vulnerable to crop damage due to climatic aberrations. They resort to agriculture in the absence of any other livelihoods option, and of late, a number of farmers and tenants have abandoned farming because they do not get the returns they expect.

Marginal Farmers

The marginal farmers in the command area mainly belong to the scheduled castes and scheduled tribes. There are a few marginal farmers from the upper castes. They cultivate small patches of land for domestic consumption. A few of them cultivate paddy for sale. They mainly cultivate vegetables as cash crops. These marginal farmers irrigate their farms manually, depending upon whether they have access to canal water, *Katas, Bandhs*[3], wells and streams. They cultivate canal beds, *Gochar* and forest lands by forming small fields. They take possession of lands below *Katas* and *Bandhs* through tenancy and cultivate vegetables there. In areas where irrigation water is available in the *Rabi* season, these farmers harvest six crops of vegetables a year, which provides them livelihood support throughout the year. Cooperative credit, equipment, seeds, fertilisers and extension services are not available to them. For credit supply, they rely on private moneylenders and microfinance institutions. They take microfinance loans by forming Self Help Groups (SHGs). A majority of loans are used for consumptive purposes, not for agriculture. In most cases, as they are unable to repay the loan amount in time, they face exploitation from their group members and microfinance institutions. Since they frequently lose their crops, their main demand is compensation for paddy producers. The command area is considered to be drought free, so there is no compensation for failure of crops due to drought like situations for

[3] *Katas* and *Bandhs* are traditional water harvesting structures.

these farmers. The farmers at the tail end of the command are facing lots of problems in bringing irrigation water up to their fields. They have less power to influence decisions about water at the village level. They are forced to work during the nights for irrigating their fields.

Their main concern is Rabi irrigation in their villages. They are demanding renovation of the irrigation system and formation of field canals for the management of irrigation water. They are also seriously concerned about industrial water allocation from the reservoir. They also think that the irrigation problem is due to industrial water intake wells in the reservoir. They are active in the farmers' union, and participate in huge numbers in agitations. However, they lack influence in the Pani Panchayat, village panchayat, and canal administration.

Agriculture Labourers

Agricultural labourers mainly belong to the scheduled tribes and scheduled castes. Agriculture is the main source of their employment throughout the year. Some labourers work in the houses of big farmers on a daily wage basis throughout the year, and are often paid half of the minimum wage. The women workers among them are more exploited. Some labourers cultivate small patches of lands using water from *Katas*, *Bandhs* and the canal, produce vegetables, and sell them in weekly markets in nearby villages. Most of them have become members of SHGs, through which they avail loans from microfinance institutions. These loans are invested for different non-productive purposes. As a result, they are unable to repay the loans, and face exploitation from group members and microfinance institutions. The younger generation in agricultural labourer families does not want to work as farm labourers. In most cases, they migrate to urban areas in search of employment. Due to a lack of agricultural labourers in the region, cultivators often bring labourers from Bolangir district or the adjacent Rayagarh district of Chhattisgarh.

Agriculture labourers have even less influence in the decision making process related to irrigation water. When faced with water shortages in the fields, they approach the land owner, not the Pani Panchayats. They have little influence on village panchayats and local politics.

Agricultural labourers are more concerned about their employment. In 2003-04, they lost work due to canal renovation which reduced the Rabi irrigation area. They are forced to work during the nights for irrigating fields. They think that their daily work problems will reduce if there is renovation and proper management of the irrigation system. They are against industrial water allocation. They think that industrial water allocation will directly hamper irrigation in the region, which will result in a loss of employment for them. Some of them think that industrial employment is contractual with heavy work load which is not their cup of tea. They are actively involved in village level farmer unions and also participate in farmer agitations many times.

Rural Youth

Youth in the region are well organised at the village level through clubs and forums, and act as a major pressure group. A number of village level struggles owe their

strength to the organising ability of the youth. They easily influence the village level decision making process. However, their participation in the political decision making processes is limited. The youth have little representation in the Panchayats and local level politics. They are in search of permanent jobs in industries or government offices. Some of them are engaged in agriculture because they do not have any other option for employment.

The youth are concerned about industrial water allocation. They think that the irrigation crisis is due to the industrial intake wells in the reservoir. According to them, heavy industries are polluting the region and decreasing the agricultural production. They suspect that heat-stress and pest attack which are now increasingly affecting crop yield are due to massive industrialisation in the region. They do not believe that the regional people's representatives will be able to do something for their employment. Some of them are demanding processing and agro-based industries for generating employment in the region. They are also concerned about the canal irrigation system and irrigation problems at the village level. They believe that the canals should be completely renovated by cement concrete lining. The youth have participated aggressively in farmers agitations during recent years. They actively support farmer unions at the village and district levels.

Fishermen

There are 10 fishery cooperatives in the Hirakud reservoir. Nearly 7,000 fishermen are members of these cooperatives. The fishermen are concerned about the water quality of the reservoir. According to them, there is 50% loss in fish production due to water pollution and fly ash contamination. Fishing provides them a source of livelihood for six months in a year. In the remaining months, they cultivate lands in the peripheral area. Most fishermen are from displaced communities and are not properly rehabilitated. They are concerned about the increase in fishing royalty in recent years. The powerful people from nearby villages forcibly put smaller mesh nets and catch fish without permission. There are direct fights and police complaints related to this issue. The cooperatives are still controlled by powerful sections in the region.

Fishermen are opposing any new industry in the region. They believe that industrial pollution and water intake will affect their livelihood. Some fishermen also participated in farmers' agitations related to industrial water allocation from the reservoir.

Farmers' Union

Farmers in the command are organised under the umbrella farmer union, the Sambalpur Krushak Sanghathan, in Sambalpur. This organisation has been strengthened owing to movements around paddy distress sale in the region during the early period of water conflicts. There are 32 different farmer unions at village levels organised around different issues specific to different villages. These farmer unions, youth groups and women groups collectively formed the Sambalpur Krushak Sanghathan. This is an active constituent of the Western Odisha Farmer Coordination Committee (Paschim Odisha Krushak Samannyaya Samiti), which is a coalition of farmers' unions in western Odisha. The coordination committee organised farmers to protest against the state government and industries. The farmers from this region

participated in agitations against the government and industries regarding lack of irrigation water in recent years.

The union believes that industrial water allocation and intake wells in the reservoir are responsible for the irrigation water crisis in the command. They claim that nearly 50,000 acres of land under the direct irrigation system is not irrigated at present. They are more concerned about the allocation of reservoir water by the state government to industries, which they feel would further aggravate the irrigation problem in the command area. They are seriously concerned about the state government's decisions to allocate water to industries, without taking into account the availability of water in the reservoir. The union is also concerned about the irrigation system and canal infrastructure, and is demanding that the canal systems be renovated. The union does not believe the government claim of surplus water in the reservoir, and questions the very reasoning for building cross bunds[4]. Some activists of the union have broken the cross bunds, and have taken water for irrigation beyond the cross bunds.

The farmers' union is strongly influencing the region, as well as the state level geopolitics. They forced the government to announce a Rs. 200 crores package for the renovation of the irrigation system. They also halted the construction work of new pipelines and intake wells by the industries from the reservoir through strong protests, and drawing a '*chashir rekha'* (farmers' line beyond which they did not allow industrial pipelines). The union has a strong influence on the district administration. They want to participate in the dialogue process with the state government for resolving the conflict, but are demanding that the state government should provide a concrete assurance related to farmer problems in the region before the dialogue.

Canal Administration and Dam Management: Engineers

The reservoir operations are under the control of the superintendent engineer and engineer-in-chief, main dam division, Burla. The irrigation administration in the Sason command has a separate subdivision at Khetrajpur in Sambalpur, which is led by a subdivision level officer for the command area. Each section has one junior engineer and four of five staff members.

The junior engineers are directly involved in the unit-wise irrigation systems at the village level, and are responsible for the irrigation system in their sections. Pani Panchayats and local people usually approach them regarding irrigation problems. The section offices are responsible for checking the amount of water flowing in the main canal on a daily basis and recording it. The staff at the section office patrols the canal banks every day to identify problems in the irrigation system. When renovation is required, the junior engineer puts together a proposal and sends it to higher authorities. The renovation and repair work of the main canal, distributary, minor and sub-minor is undertaken through private contractors under the supervision of the sub-divisional officer and junior engineer.

The canal administration in the command is under pressure to meet the increasing demand and they are not able to meet demands and expectations on the basis of the present poor canal infrastructure. There is a lack of any official control on the irrigation water flow at the distributary level. The distributary gates are manually operated by

[4] Cross bunds have been constructed in the canal by the administration, beyond which water is not made available for irrigation, though the area forms part of the command.

villagers; most of the times the gates are stolen. The canal administration faces a backlash from farmers at the tail ends who cultivate the lands beyond cross bunds. During the late Rabi season, the farmers and canal administration are forced to work at night in the fields because water is supplied at night. When the water shortage in the tail areas becomes more severe, the canal administration begins weekly rotation of water supply at the distributary level. By closing water supply to some distributaries for a week, they deliver water to the tail end region of other distributaries. Though in most instances farmers cooperate with the canal administration for managing irrigation water during the Rabi season, there are nevertheless many instances of open clashes among farmers, as well as between farmers and the canal administration.

The canal administration feels that the problems are due to the lack of irrigation management, water seepage, leakage, and canal infrastructure. They attribute the mismanagement of irrigation water to the increased ayacut area beyond the designed ayacut. They are more concerned about the present canal infrastructure which is under pressure to supply irrigation water due to the increased demand. Some officers unofficially agree that they are forced to discharge more water than the capacity of the main canal because the demand for irrigation water has increased. The canal administration is demanding that the irrigation system be renovated with cement concrete lining of canal beds for an efficient irrigation system in the entire command. They feel that the role of Pani Panchayats in irrigation management is crucial.

There is a lack of coordination between the canal administration and the Command Area Development Authority (CADA), which is responsible for developing field channels for the effective management of irrigation water. The CADA works independently with Pani Panchayats and does not consult the canal administration. The village level agricultural officers also have no linkages with the canal administration. However, the canal administration has a strong coordination with Pani Panchayats despite strong differences about irrigation water distribution and management.

The dam management which regulates reservoir operations for Hirakud claims that water meant for irrigation is not allocated to industries. According to them, only surplus water is given to industries. Further, they feel that industries are using less water than that which is allocated to them. The industrial water allocation is done according to the orders received from the state level Water Allocation Committee by Hirakud authorities. The officers have the power to check industrial water utilisation. However, their accessibility to industrial units is a matter of debate. There are allegations that the industrial units are using more water than that allotted through the MoUs. Industries are also not paying water cess regularly. Water Resources Department (WRD) officials feel that the industries should make their plan for water utilisation during the lean period, and should not over-extract groundwater.

Engineers are more concerned about the increase in paddy cultivation area in the command. Some officers perceive that the farmers are not serious about water management, and that they are wasting irrigation water in the command area. The dam authorities are willing to participate in the process of dialogue to resolve Hirakud water conflicts, if they are given such instructions by the Water Resources Department.

Command Area Development Authority (CADA)

The CADA is the centrally sponsored agency for the development of the irrigation potential of the command area. The CADA receives 60% of its funds from the central government, 30% from the state government, and the remaining 10% is supposed to be collected from farmers. The Sambalpur division has a regional office in Sambalpur city, with the executive engineer as its chief. The CADA began its work in the command area in 1971. The major responsibility of the agency is to construct field channels below water courses, minors and sub-minors for the proper utilisation of irrigation water at the field level. Its second responsibility is to design and construct drain channels for water discharge from waterlogged areas.

The work of the agency was limited due to lack of funds in the initial period. The early work done by the agency in the command area was destroyed after two to three years. The CADA receives Rs. 15,000 per hectare as funding for one time work, and Rs. 6000 per hectare for maintaining the channels. These funds are not sufficient for cement concrete channels. In the field, they are working with Pani Panchayats for construction of field channels. The shortage of funds allows concrete work only on a small area. The remaining channel is constructed by earth work. The earth work is destroyed by farmers during the Kharif cultivation when there is less demand for irrigation water. However, during Rabi irrigation when these channels are needed, there is absence of any infrastructure to manage water at the field level. The irrigation water floods the entire field and flows from one field to another. Some villages do not agree with the land settlement and consolidation, and cultivate small patches of lands. The construction of field channels is hindered due to the farmers' refusal. In most instances, the agency followed settlement reports when they went to construct field channels at the village level. This created problems in villages since farmers did not agree with the settlement report. As a result, many field channels were wrongly aligned. In recent times, the CADA is receiving some funds from the WRD for the construction of field channels. The recent work of the CADA is yielding good results in irrigation water management in some areas.

CADA has good interlinkages with Pani Panchayats in the recent period. It is also connected with the WRD, but there is a lack of linkages with the canal administration in the command area.

Pani Panchayats

The Pani Panchayats are Water Users Associations (WUA) in the command area which were formed after the enactment of the Orissa Pani Panchayat Act 2002 and the Orissa Pani Panchayat Rules 2003. In every unit of canal irrigation system (usually the command area of a minor), there is one Pani Panchayat which is responsible for managing the irrigation water in that unit. The management body is elected by farmers who own farms in that unit. The representative body elects the president, vice president, secretary and treasurer. Pani Panchayats are provided an annual allocation from the government for maintaining the irrigation system in their units. All the Pani Panchayats along a distributary come together to form a distributary level committee to manage irrigation water at the distributary level and upwards. Four apex bodies of Pani Panchayats are supposed to be present in the command area. The formation of the project level apex body of Pani Panchayats was pending till 2011, when the study was carried out.

All Pani Panchayats had received annual operation and maintenance (O & M) funds during the first year of establishment, but since then many have not received any funds for the last seven years. The presidents and respective bodies have more grievances. They feel that they have been formed not to maintain the irrigation system, but to face the anger of farmers without any support from the state government. They are not being consulted by the canal administration about the quantity and period of water discharge in the main canal. According to the Pani Panchayat Act, they are responsible for formulating estimates for renovation work at the distributary, minor, sub-minor, and field channel level with the help of the concerned government officer. However, the Pani Panchayats seem to have no clear idea about renovation work related to the irrigation system in their units. The canal administration estimates the funds required and renovates the system without involving the Pani Panchayats. There is a perceptible communication gap between the Pani Panchayats related to the decision making process about irrigation water. There is no joint decision making; periodic meeting with all Pani Panchayats are hardly organised. The Pani Panchayats lack decision making powers at their unit level or in apex body committees related to irrigation water. For conducting any official process, Pani Panchayats are required to obtain permission from the irrigation administration. According to the Pani Panchayats, though they have been entrusted with responsibilities to ensure irrigation water up to the tail end, they are not being enabled and empowered to do so.

At present, the CADA is working with some Pani Panchayats towards the formation of field channels, which is yielding good results in delivering irrigation water up to the tail ends in some units.

With the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS), all Pani Panchayats now get a letter towards the end of the Kharif season from the WRD to formulate estimates of renovation works up to Rs. 3,00,000 with the help of the sub-divisional officer. However, Pani Panchayats are unable to take on this work because the local labour rates have gone up, and no daily wage labourers are available at minimum wages specified under the MGNREGS. They are also unable to formulate proposals without the requisite training from the government. In spite of this, Pani Panchayats are trying their best to manage irrigation water. During the period of high demand, they coordinate with the canal administration and convince head reach farmers to leave water for the tail reach areas.

There are a number of conflicts related to irrigation water distribution. Pani Panchayats try to resolve these conflicts[5] at the village level.

Pani Panchayats are a major influential group in the command area. They are in a position to influence the district administration, irrigation administration and regional politics. There are a number of Pani Panchayat members who are active members of the village and district level farmer unions. They participated in farmers' agitations in recent years. They are concerned about industrial water allocation. They too think that water shortages in tail areas are due to industrial water allocation. Some Pani Panchayat members are saying that if they get enough water up to the tail ends, they would not be concerned about how the government allocates the remaining water.

[5] The Mudhenpali unit in the upper Huma section resolved the irrigation problem up to a large extent by making collective decisions and rotating the irrigation water supply. The Pani Panchayat brought all farmers together and formulated a time table for water sharing in the fields. As a result, water now goes up to tail ends, and a large area gets irrigated by a limited quantity of water.

They are more concerned about the canal infrastructure at their level. They are also demanding more cement concrete lining of the irrigation system. They are saying that CADA works should be promoted for effective irrigation water management. The Pani Panchayats are interested in participating in a dialogue process related to the Hirakud water conflict.

Panchayati Raj Institutions/ Other People's Representatives

The Panchayati Raj Institutions (PRI) and people's representatives actively participated in the agitation. In most cases, the representatives from PRIs from different political parties kept their party politics aside and participated in farmers' agitations. During the initial period, there was a lack of participation from the representatives, but as the agitation became intense, their participation started to increase due to popular pressure.

The people's representatives and the government were forced to talk about the irrigation issues concerning farmers due to public pressure and the upcoming elections. In the later stage of the agitations in 2007, different political parties started to put their political agenda before farmers. In this period, it became clearly visible that the water problem of farmers can be an important issue for getting votes. However, after the elections, the representatives are not interested in resolving the irrigation related issues of farmers in the region.

The internal power and interest conflict between the village panchayats and Pani Panchayats is becoming more prominent in the recent period. The PRIs and representatives are concerned about irrigation and the farmers' situation in the region. However, there is a lack of any constructive work by them. The PRIs and representatives influence village politics, the local administration, state government, and the regional media.

Local Civil Society Organisations

The local civil society organisations (CSO), most of which are non-government organisations (NGO), have strong relations with farmers and civil society through their active work on important issues. The local CSO, Water Initiative Orissa (WIO) is actively involved in this conflict. Through documentation, media advocacy and public awareness related to the water conflict in the region, they have contributed to the intensive public debate when agitations in the region were at their peak. This organisation organised various workshops, awareness programmes and public consultations on water issues in the region. At present, they are actively working on water related issues including pollution in the Bheden, farmers' suicides in the Hirakud command, and climate change impacts on the region.

Manav Adhikar Seva Samiti (MASS) is a grassroots organisation working on human rights and different livelihood issues in western Odisha. With working experience in Joint Forest Management and environmental conservation, this organisation has a clear understanding of the water conflict and its consequences in the region. It actively participated in farmers' agitations and did intensive work to raise awareness among farmers about water conflict.

CSOs from the region are able to influence the state government, the regional administration and local decision makers. They are also able to influence the local people, especially farmers and citizens. These organisations are actively working and continuously writing on water related issues, which raise awareness among farmers and local people related to water conflicts in the region.

Academicians and Environmentalists

Academicians have played a key role in bringing forth the issues related to water conflicts in the region. A few of them were actively involved in the debate with government authorities related to water conflicts. These academicians are retired professors, engineers, government officers, journalists and researchers. They played a crucial role in generating a public debate during the initial period of farmer agitations.

They are more concerned about reservoir operations, inflow quantity, inflow quality, siltation, dam safety, gradual decrease in the irrigation area, and industrial water allocation. According to them, industrial water allocation was not mentioned in the original Detailed Project Report (DPR). They said that before 2001 there was a nominal amount of water being used by industries. However, the state government allotted 0.350 Million Acre Feet (MAF) water to the industries in 1991. Karunakar Supkar, a retired electrical engineer, believes that the industrial water allocation at present will not hamper direct irrigation. However, it is affecting electricity generation, drinking water supply to Sonepur and Bolangir towns, and delta irrigation, as per his opinion.

Academicians demand that before allocating water to industries, the government should make it clear that it will not affect the direct and delta irrigation. Artabandhu Mishra, a retired professor from Sambalpur University, is concerned about the safety of the dam and its capacity for flood control. According to him, the dam was unable to control floods in most instances in the delta region of the Mahanadi. He also feels that the dam is not reaching the Full Reservoir Level many times. Academicians and researchers are active in writing about Hirakud water issues in newspapers. In September 2011, researchers and academicians brought out lots of information related to reservoir operations and flood control, which fuelled an intense debate around water among politicians and bureaucrats.

This intelligentsia also demand better renovation works in the command area and the proper management of irrigation water. Academicians have a direct relationship with farmers' unions and participate in farmer agitations. They can easily influence the state government and district administration. They are interested in participating in the dialogue process related to Hirakud water conflicts. They think that initiating a dialogue process is a better way to resolve the conflict.

Hirakhand Nagarika Parishad

The Hirakhand Nagarika Parishad is a senior citizens forum in Sambalpur town. They are working on different issues related to water conflicts in the region. They were the first to suspect that industrial water allocation and increasing water pollution in the reservoir was hampering irrigation. They wrote to the President of India asking for an

investigation into the matter. This forced the state government to set up a high level technical committee to report on the issue. The Parishad is concerned about pollution and the quality of water in the Mahanadi river. Dilip Padhi, President of the Parishad says that the Mahanadi water has now become 'D' grade[6]. They suspect that the industrial effluents and fly ash are contaminating the reservoir water. They think that further industrial water allocation will affect irrigation in the command area. They are demanding a better irrigation system in the command area. They actively participate in farmers' agitations and support farmer unions. They can easily influence the district administration and regional politics. They are willing to participate in the dialogue process related to the Hirakud water conflict.

Industries

Industries from Jharsuguda and Sambalpur districts which are using water from the reservoir are major stakeholders in the Hirakud water issues. Farmer agitations prevented them from drawing water directly from deeper locations in the reservoir. The intake wells by the industries are situated on the periphery of the reservoir. These intake wells are able to lift water when the reservoir level is more than 595 feet. According to Karunakar Supkar, they are influencing the state government and Hirakud authorities to maintain the reservoir level up to 595 feet throughout the year. Water demands from industries have increased manifold suddenly after 2005, owing to the establishment of a large number of captive and independent thermal power plants in the region.

The industrial water intake from the reservoir is mainly by major heavy industries (steel and alumina) having captive power plants. Small units such as sponge iron, small steel plants, and coal washeries are dependent on water from the Ib river, upstream of the reservoir. During lean periods when there is a lack of water in the Ib River, these small units are forced to shut down. Some units have constructed storage facilities for surviving in the summer. However, the storage facilities are not adequate for meeting their demands in lean periods. Recently, when the state government banned deep bore wells in industry premises and increased the water cess, the industries protested strongly. They have submitted their memorandum to the WRD regarding water availability and cess issues.

Water cess is collected according to the overall amount of water sanctioned for the entire year. The industries are demanding cess collection according to the meter reading, instead of basing it on overall allocation. According to them, they are using less water than allocated. It is clearly seen that small units in the region are facing water problems more than the larger units. However, there are a number of units which are using water without an official agreement with the WRD, and also using groundwater for plant operations.

Industries demonstrate their concern about irrigation water supply for farmers. They fear that when the reservoir level will became low in the future, there would be water shortages for their daily operations. Industries in the region strongly influence the district administration, regional politics and the state government. They want to participate in the dialogue process related to water conflicts in the Hirakud reservoir.

[6] As per the State Pollution Control Board

Print Media

The print media is actively involved in water conflicts related to the Hirakud reservoir. During the period of farmers' agitations from June 2005 to December 2009, the media aggressively reported the water conflicts through news articles, columns and briefings. They played a major role in spreading awareness among the farmers. They made a critique of the state water policy, reservoir operations and industrial activities in western Odisha.

The local newspapers give top priority to water conflict related news in their daily editions. Local newspapers have good distribution networks in remote parts, which are easy channels for spreading information related to water conflicts in the region. They played a crucial role in taking the views of the farmer union to their readership. Through an intensive campaign against the position of the government, committees and industries, the media fuelled a public debate about the Hirakud water distribution, and the present situation of the reservoir.

Along with the issues of water conflicts, the media also revived the focus on the issue of rehabilitation for those displaced by the reservoir. Fifty three years after the construction of the Hirakud dam, there are a number of families who have not been rehabilitated. The media has also discussed the water pollution due to industrial effluents, and air pollution due to fly ash.

According to the media, further water allocation to industries from the reservoir would hamper irrigation in the region. The media is not against industries in region. However, they strongly criticise the presence of a large number of mineral-based heavy industries in a cluster. They are also against industrial pollution, and further lifting of water from the reservoir by industries. In December 2010, the media reported that a huge amount of water cess has not been paid by the industries, which made fishermen and farmers angry. The people started to question the state government about the pending water cess payments for water by industries.

At present, the media is writing articles about the interstate water issue between Chhattisgarh and Odisha related to Mahanadi water sharing. Media strongly influences the region, the farmers' union, the state government, administration and industries.

Activists

Activists in the region were exposed to previous movements in the state. The activists have participated in the Kashipur Movement against Utkal Alumina in Rayagada, the Gandhamardhan movement against Bharat Aluminium Company (BALCO) in Bolangir, the Niyamgiri movement in Kalahandi and the Gopalpur movement in Ganjam. Since the 1990s, there are a number of ongoing struggles in Odisha to save land, water and forest resources from being usurped by industrial and mining establishments, and secure them for the communities.

The exposure and experiences from these struggles have contributed significantly to the industry vs agriculture water conflict around the Hirakud reservoir. From 2005 to 2007 when there was water shortage for irrigation in the Sason command, activists

took up the issue of irrigation water shortage and industrial water intake from the reservoir at every village level in the command area. During the peak period of the farmers' movement related to irrigation water, activists organized village level meetings and bicycle rallies in the region. Due to the continuous efforts of activists, there was intense participation from farmers in every agitation.

Stakeholder Value Analysis

At present, the industry vs agriculture water conflict is not at its peak level, as it was in 2005- 07. The analysis is thus being conducted after the peak period of the conflict. The main aim of this analysis is to find out common, uncommon, accepted and unaccepted values among stakeholders. The synthesis of a common value tree for the stakeholders will help to understand the value typology among the stakeholders. This analysis will help to bring stakeholders together on the basis of their common and acceptable values, on order to negotiate about unacceptable values. Through this analysis, we can predict the possibility of future conflict among the stakeholders in the region.

Table 9.1: Stakeholder groups, interest and values

Group	Sr.No.	Components	Interest	Value
Primary user	1.	Big Farmer	Economic, social as well as cultural	Livelihood and sustenance
	2.	Small Famer		
	3.	Marginal farmer		
	4.	Agricultural labourer		
	5.	Youth		
	6.	Women		
State agencies dealing with water	7.	Water Resources Department	Social and economic	Water allocation and management
	8.	Irrigation administration		
	9.	Command Area Development Agency		
	10.	Pani Panchayats		
	11.	Soil Conservation Department		
Alliances	12.	Farmer Union	Social	Water justice
	13.	Civil society		
	14.	Citizen forums		
Academicians and environmentalists	15.	Individuals	Socio-environmental	Impact on ecosystem and environment
Industries	16.	Companies	Economic	Economic gain
Media	17.	Print and audio-visual media	Social	Information Dissemination
Panchayati Raj and representatives	18.	Panchayati Raj institutions	Socio-political	Political decentralisation
Fishermen	19.	Fishing co-operatives and fishermen	Economic	Socio-economic sustainability
Agricultural Department	20.	Agricultural Technology Management Agency (ATMA)	Social and economic	Agricultural Development
		Soil testing laboratory, Sambalpur		
		Organic farming unit		

Table 9.2: Stakeholder linkage matrix

		BF	SF	MF	LL	Wo	Yo	FU	CF	Ac	PP	CADA	SCD	WRD	IA	Id	ER	FI	Me	AT	ST
Big Farmer	BF		S	S	S	W	S	S	M	L	S	M	L	S	S	L	S	M	S	M	M
Small Farmer	SF	S		S	S	W	M	S	W	L	S	L	W	M	S	L	M	M	M	M	M
Marginal Farmer	MF	S	S		S	M	W	S	L	L	M	L	W	M	S	L	M	M	M	W	W
Agricultural Labourer	LL	S	S	S		S	W	S	L	L	L	L	L	W	L	L	W	W	W	W	L
Women	Wo	W	W	M	S		W	M	W	W	L	L	L	L	L	L	L	L	L	M	L
Youth	Yo	S	M	W	W	W		S	W	L	M	L	L	L	L	W	W	M	M	W	L
Farmer union	FU	S	S	S	S	M	S		S	M	S	W	L	S	M	L	W	M	S	M	W
Citizen forums	CF	M	W	L	L	W	W	S		S	W	L	L	M	L	L	W	L	S	L	L
Academicians	Ac	L	L	L	L	W	L	M	S		W	L	L	M	L	M	W	L	S	L	L
Pani Panchayats	PP	S	S	M	L	L	M	S	W	W		S	L	S	S	L	M	L	W	L	W
Command Area Development Agency	CADA	M	L	L	L	L	L	W	L	L	S		L	W	M	L	W	L	W	L	W
Soil Conservation Department	SCD	L	W	L	L	L	L	L	L	L	L	L		W	W	L	W	L	W	L	W
Water Resources Department	WRD	S	M	L	W	L	L	S	M	M	S	W	L		S	S	M	S	M	M	W
Irrigation Administration	IA	S	S	M	L	L	L	M	L	L	S	M	W	S		W	M	L	M	W	L
Industries	Id	L	L	L	L	L	W	L	L	M	L	L	L	S	W		S	W	M	L	L
Panchayati Raj elected representatives	ER	S	M	M	W	L	W	W	W	W	M	W	W	M	M	S		M	M	M	L
Fishermen	FI	M	M	M	W	L	M	M	L	L	L	L	L	S	L	W	M		M	L	L
Media	Me	S	M	M	W	L	M	S	S	S	W	W	W	M	M	M	M	M		M	W
Agricultural Technology Management Agency (ATMA)	AT	M	M	W	W	M	W	M	L	L	L	L	L	M	W	L	M	L	M		S
Soil Test Lab	ST	M	M	W	L	L	L	W	L	L	W	W	W	W	L	L	L	L	W	S	
Vermicompost Unit	VU	W	M	W	W	W	W	W	L	L	L	L	L	L	L	L	L	L	L	S	S

Strong linkages: S; Medium linkages: M; Weak linkages: W; Lack of linkages: L. The linkages considered here are based on reservoir water sharing and related issues. These linkages may be positively or negatively motivated.

Fig. 9.1: Stakeholder Sociogram (See table 9.3 for explanation on the linkages between stakeholders)

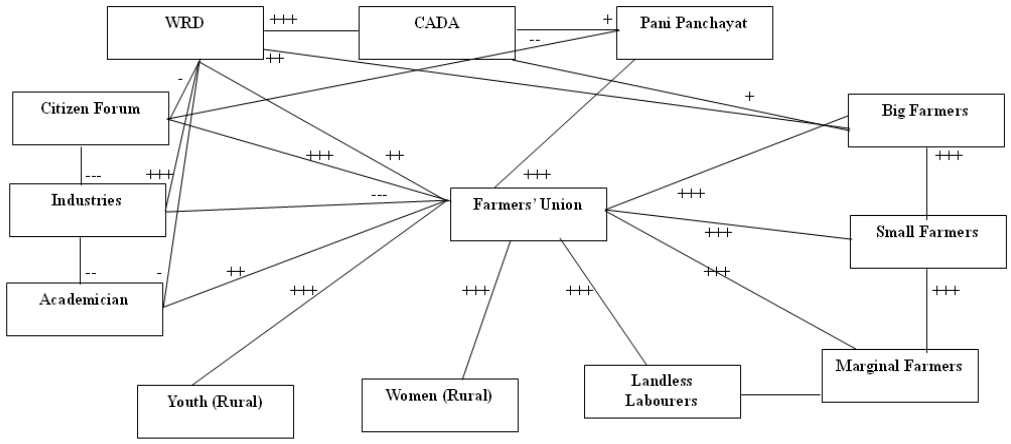


Table 9.3: Stakeholder Sociogram

Sr. no	Line starts from	Line Ends at	Strength
1.	Farmer Union	Pani Panchayat	+++
2.	Farmer Union	Big Farmer	+++
3.	Farmer Union	Small Farmer	+++
4.	Farmer Union	Marginal Famer	+++
5.	Farmer Union	Land Laborer	+++
6.	Farmer Union	Women (Rural)	+++
7.	Farmer Union	Youth (Rural)	+++
8.	Farmer Union	Academicians	++
9.	Farmer Union	Water Resources Department (Hirakud Dam Circle)	++
10.	Farmer Union	Industries	---
11.	Farmer Union	Citizen Forums	+++
12.	Water Resources Department (Hirakud Dam Circle)	Big Farmer	++
13.	Water Resources Department (Hirakud Dam Circle)	Pani Panchayat	+++
14.	Water Resources Department (Hirakud Dam Circle)	Citizen Forums	-
15.	Water Resources Department (Hirakud Dam Circle)	Industries	+++
16.	Water Resources Department (Hirakud Dam Circle)	Academicians	-
17.	Pani Panchayat	Command Area Development Agency	+
18.	Pani Panchayat	Citizen Forums	--
19.	Big Farmer	Command Area Development Agency	+
20.	Big Farmer	Small Farmer	+++
21.	Small Farmer	Marginal Farmer	+++
22.	Academicians	Industries	--
23.	Industries	Citizen Forums	---

Legends	
+++	Good relations; their functions are interrelated.
++	Good relations, but there are differences in perception about the conflict.
+	They have a relationship with each other but are having difficulties.
_	They are working on the same issue but have different perceptions about the conflict.
_ _	Their relations are not good; they have different perceptions about the conflict.
_ _ _	They do not tolerate each other.

(The interrelationship between stakeholders is based on the reservoir water issues.)

Analysis and Discussion

The farmers group has members with different levels of power and influence. In the command area, the intensity of water shortage for irrigation for a particular group is dependent on its location in the canal system, in the power structure, in the nature of its interest, and the degree of influence it can command. Lack of irrigation in the tail areas has its genesis in the period in which the irrigation system in the region was set up. Before the industry vs agriculture conflict, farmers were mobilised by the paddy distress movement against under-rate selling of paddy. The lack of water for irrigation

in 2005 coincided with the industrial intake of water from the reservoir, and swung the attention of the farmers' group toward this conflict. The conflict became intense when the entire irrigation in the Sason command came under threat. As a result, farmers were mobilised on the issue. Marginal stakeholders such as landless labourers, women, small farmers and tribals, along with powerful youth groups, were easily mobilised during the peak period of the conflict. The participation of different sections of society in agitations and protests brought intense pressure on the state government. The impact of water shortages for irrigation was limited to the Sason command. However, participation in the conflict from other areas shows concerns and fear shared by all farmers that they were going to lose their share of water from the reservoir. The water shortages in tail areas and further fear related to the lack of water for irrigation brought more homogeneity among farmer groups. The farmers' union (the Western Odisha Farmer Coordination Committee) used simple techniques such as a letter campaign, human chain, street plays, songs, village corner meetings and bicycle rallies to create awareness among farmers.

The power structure among farmer group influences decision making related to irrigation water. Distribution of irrigation water in the command area is influenced by big farmers. Pani Panchayats and Panchayati Raj Institution are dominated by big farmers. During the peak period of the water conflict, big farmers remained powerful and decisive participants from the region.

Vulnerability among farmer groups is increasing with time. A lack of sustainability in agriculture, mono cropping, erratic rainfall and drought is worsening their situation. Reduced government support, declining productivity and dwindling economic returns are increasing their frustration. In recent times, there is a substantial increase in farmer suicides in the region. Incomplete land reforms raise issues of resource distribution among weaker sections in the region. Tenancy and sharecropping is prevalent due to hidden landlordism. Unregistered tenancy and sharecropping is resulting in a lack of social security among tenants. Tenants and sharecroppers are major victims of water shortages for irrigation.

The Hirakud reservoir has left a negative impression in the minds of people from the region from the time of its formation. Fifty-three years after construction, the rehabilitation issue is yet to be resolved. In the peripheral area of the reservoir, we can easily identify many families who have been displaced two to three times during the last fifty years. The proposed lift irrigation from the reservoir for drought prone areas as promised in the project report was shelved and never materialised. At present, the situation of farmers in the peripheral region is worse than that of farmers in the command area. The shortage of irrigation water in tail areas is increasing frustration and anger. In the coming period, any large shortage in irrigation water supply can result in an intense water conflict in the region.

The Hirakud reservoir contributed greatly to the beginning of the industrial era in the history of Odisha. Industrial units at Hirakud, Brajrajnagar, Rourkela and Cuttack were dependent on the reservoir for hydroelectricity. Besides flood control and irrigation as main priorities, hydropower generation remained an important priority for reservoir operations up to 1990. The opening up of the Indian economy for private investment in the 1990s initiated a new industrial expansion. The state government reserved water

for industrial purposes from the reservoir in 1990. The industries that were set up in the region after 1990 were based on mining and thermal power production. The availability of coal in the Ib river valley, the abundant minerals of the region, and the availability of water from the reservoir helped to establish mineral based industries on the periphery of the reservoir. Most industrial units in the region are producing sponge iron, steel and alumina, and captive thermal power.

The industrial water demand and share are increasing with time. This is due to an increase in electricity consumption and aluminium export in India. The early stage of conflict (2005) was caused by the blatant withdrawal of water from the reservoir by Bhushan Power and Steel Ltd. While the peak period of the conflict has passed, it has had a significant impact on water intake by industries from the reservoir. Industrial efforts to put intake wells in the deep water of the reservoir have been halted, and some industrial units have been forced to abandon their new water pipeline projects for the intake of water.

Industries are using all their power to influence the state government for a favourable decision about reservoir water. Through local connections and money pressure, industries have been able to secure their interests related to water supply. In spite of being denied deep water intake wells, they managed to get continuous water supply even during the peak period of the conflict. Industries have indirectly provided support to some farmer groups to neutralise farmer agitations against water intake from the reservoir. The industries that suffer from water shortages during the lean period are the small industrial units, not the big ones. They do not have direct access to water from the reservoir; they have to lift it from the Ib and Bheden rivers. In fact, during the lean period these rivers too become dry resulting in water shortages for small units.

The industries are getting more and more concerned about the possibility of the conflict re-emerging. There is also unrest in the region related to employment of local people, compensation and displacement from the peripheral area. There are cases of violent attacks on officials of industries from the region.

Up to 1962, during the construction and commissioning of the reservoir, decision making rested with the Ministry of Irrigation and Power of the central government. From 1962, the reservoir was handed over to the Odisha government. At present, reservoir operations and management is the responsibility of the Water Resources Department, while hydroelectricity generation is the responsibility of the Odisha Hydropower Corporation (OHPC). The coming of new water policies and the neoliberal understanding of the state government brought about lots of changes in water governance around the Hirakud reservoir. In 2003, for the first time, the irrigation system was handed over to farmers through Pani Panchayats under the Pani Panchayat Act 2002. However, there has been a gradual reduction in the irrigation administration staff. Lack of training, lack of empowerment and poor water governance have not allowed Pani Panchayats to play their role in maintaining and operating the irrigation system. During the peak period of the conflict in 2007, water from the reservoir became a major political issue in Odisha. The ruling party feared that they would lose during the upcoming elections. The opposition started to support the farmers' cause through rallies and public gatherings. With elections forthcoming, the

political conflict around water intensified. The state government was forced to set up different committees and make announcements that reservoir water was only for the farmers. It was repeatedly clarified that the farmers' share of water will not be given to industries.

The conflict began as one over industrial water intake from the reservoir, and lack of water for irrigation. Gradually, it has become an industry vs agriculture conflict. However, both industry and agriculture are not homogenous entities or stakeholders. There are a number of intra-sectoral and inter-sectoral water issues in the region that cut across these divisions. Within the agriculture sector, conflict over access to irrigation water between the head and tail reaches of canals and distributaries is not apparent. The lack of irrigation water in tail areas is a decade long problem within the command area. Water distribution at the distributary, minor, and sub-minor level is influenced by powerful sections from villages who secure their own interests at the expense of others.

Within industry too, the situation is not uniform. The mega industrial units take water directly from the reservoir through intake wells and long pipelines. They do not face problems of water shortages during the lean period. However, small units based around the Ib and Bheden rivers face water shortages during the lean period. Some units store water for lean periods, while some extract groundwater. Regardless, many units are forced to shut down due to water shortages.

The fishermen are facing a loss in fish production due to fly ash contamination and water pollution. A numbers of fish varieties vanish due to water pollution in the reservoir. The illegal fishing by powerful local people carried out using small gauze net is depriving fishermen of their livelihood.

The longest successful movement against pollution in the Hirakud reservoir region was against the Orient Paper Mill, Brajrajnagar. However, the current pollution of reservoir water is much more severe than that caused by the Orient paper mill. Fly ash contamination, ash ponds around the reservoir, and industrial effluents containing arsenic, fluoride and other heavy metals are harmful for the biota, fish and agriculture in the command area. The reservoir is a major source of drinking water for downstream towns and cities; its pollution is endangering public health in the region. Perhaps, water pollution and its impact on human lives, agriculture and fishery could bring diverse stakeholders on one platform to influence decision making around the Hirakud reservoir.

10 Chapter 10
Stakeholder Consultations

For an acceptable and just resolution to any conflict, open and patient discussions among stakeholders are crucial. They help stakeholders understand one another's positions better in the changing contexts, and also provide opportunities for more holistic appreciation of issues and options. By enabling better and reliable firsthand comprehension of the situation and one another's positions and arguments, stakeholder dialogue acts as a logical platform to explore conflict resolution.

Under this action research, the state centre tried to engage stakeholders in dialogue processes. However, considering the strong convictions of stakeholders and their adopted stands/positions, it was decided that consultations would be held with each stakeholder group separately. The objective was to share with each group the state centre's conflict analysis with a broader picture of issues influencing the conflict directly and indirectly, and to seek their feedback for a multi-stakeholder dialogue. Towards this, apart from interactions with farmers and fishermen stakeholders, the state centre also organised separate meetings with representatives of different stakeholders groups as part of its consultation process, using the platform of various workshops and events.

This chapter presents a brief account of these meetings and different stands taken by the stakeholders. Farmers, academicians, fishermen and activists participated more actively in these dialogue processes. They articulated their concerns elaborately at every consultation. The participation of the state government was mostly indirect, through individual interactions and consultation in other forums. The participation of industries in the dialogue process has been very limited. The implications of the dialogue process are taken into account in the next chapter which concludes the report.

Meeting of the Committee on Hirakud Water Conflict

A committee of experts and key stakeholder representatives was formed at the outset, after obtaining their consent to guide the research team in fulfilling its action research objective. The meeting of the committee on Hirakud water conflict took place on 27th July, 2010 at Sambalpur, to discuss the processes and pathways for the Hirakud action research project.

The members of the committee shared their common concerns about the Hirakud conflict. The participants raised the following issues related to water conflicts in the region:

1. **Water to industry:** Water to industry was not included in the detailed project report (DPR) of the Hirakud dam. The major priorities were flood control, power, irrigation, fisheries and navigation. However, some industries like Indian Aluminium Co., Ltd. (INDAL) (since 1956), Odisha Power Generation Corporation (OPGC) (since 1990), Indian Railways at Jharsuguda and Belpahar, etc. were allowed to use water from the reservoir. The ongoing massive industrialisation in this region, however, does not take into consideration the availability of water, or the carrying capacity of the area. While the life of the extractive mineral based industries, being promoted at the cost of farmers, citizens and the local environment, may not be more that 30 years, future generations are poised to suffer from substantially reduced water availability and quality. Most industries are export oriented. They are affecting and compromising local livelihood needs for the greed of people outside the region. They should be banned. While industry is allowed to lift water from the reservoir, farmers are not allowed to lift water even with a 1 horsepower (HP) pump. There are incidents of the Water Resources Department (WRD) filing first information reports (FIRs) against farmers in the Rengali block for lifting water from the reservoir. In 1964, a proposal for lift irrigation from the reservoir to irrigate upstream areas was dismissed by the WRD, as dam authorities felt that irrigation and power production would be compromised. However, in 1990, the government decided that 10% of the water from the reservoir could be supplied to industries.

2. **Pollution:** Pollution due to the discharge of effluents from industries critically affects the quality of drinking water as well as agricultural productivity. Due to pollution in the Sason canal command area, the agricultural productivity has been reduced to the extent that only 12-15 bags per acre were produced this year, compared to about 30 bags per acre in the past.

3. **Resettlement and Rehabilitation (R & R):** The Hirakud dam submerged 283 villages, of which 53 were not interested in moving. A total of 1.83 lakh acres of land has submerged, of which 1.23 lakh acres were highly fertile. R & R compensation has not been paid to many till date.

4. **Interstate issues:** The inflow to Hirakud has decreased due to the construction of new dams and reservoirs in Chhattisgarh. Three major and 36 medium projects have come up after Hirakud with an increase of 11 times in the irrigated area upstream. Over the last 50 years, the water level in the reservoir reached 630 ft on 1st November only 28 times. The reduction in the inflows to the Hirakud reservoir is a major cause for concern. The arrangement between Odisha and Chhattisgarh in this regard is not clearly spelled out.

5. **Command area issues:** Water loss through seepage in the canal must be prevented by farmers. Increase in fluorosis in the command area has been recorded, with an estimated 6-7 cases of affected people in a population of 1000. The people in the command area are facing adverse conditions because the 83 km long Sason canal was repaired four times, which led to its closure. The first phase of canal modernisation work started in 2002-03, for which the canal was closed for two years, resulting in a loss of about Rs. 80 crores for the farmers. What is more troubling is that even after the repairs, the water availability in the command has reduced. The Command Area Development Authority (CADA) has not fulfilled its responsibilities at all. The water use efficiency and cropping pattern has been an issue. There are no

field channels in the command. The farmers at the tail end area are not getting water. While government figures put the culturable command area (CCA) without irrigation at about 20,000 acres, this area is 50,000 acres according to citizens.

6. **Fishing issues:** There is no concern for the livelihood of the fishing community. About 25,000 families of fishermen depend on the Hirakud reservoir. There has been an estimated 42% reduction in fish yield. Due to pollution, only 43 out of 183 fish varieties are now found in the reservoir.

7. **Water allocation and reservoir operation:** Loss of power production due to increased water allocation to industries is about Rs. 4-5 crores/year. The water used for power generation is linked with the environmental flow in the river, and is also used for the purpose of drinking water downstream of the dam. These needs are being adversely affected by the reduced availability of water due to power generation. A minimum environmental flow is not maintained. Reduction in power generation is also affecting delta irrigation. While Taladanda and Machhgaon canals in the delta irrigation area are supposed to cover a CCA of 4 lakh acres together, the actual coverage is 1.55 lakh acres only.

Overall, the members of the Hirakud committee felt that the conflicts around the Hirakud reservoir should not be considered insignificant. As the government was supporting industries, they saw the conflict as a war between people and the industries. The civil society, therefore, should support the people, and state centre of the Forum being a civil society initiative, they wanted it to take sides. However, while some members blamed insufficient water (reduction in inflow) in the reservoir and growing allocation to industries as the real cause of the conflict, others felt that faulty reservoir operations and inappropriate water distribution, management and cropping are also issues which cannot be overlooked.

Water Conflict in Odisha: Issues and Way Forward

A 2-day Workshop on “Water conflicts in Odisha: Issues and way forward” was organised on 28th – 29th March, 2011 at Bhubaneswar by the state centre. Environmental activists, thinkers, academicians, government officials, farmer leaders and civil society organisations from different parts of the state participated in the workshop, along with members of the National Steering Committee of the Forum, to discuss the ongoing and emerging water conflicts in different geographies of the state. The first session exclusively centred on the water conflicts around Hirakud, with an eminent panel consisting of farmer and fishermen leaders Lingaraj, Ashok Pradhan and Gopi Majhi from the Hirakud region, senior researchers and academicians Prof. Artabandhu Mishra and Prof. D. P. Nayak from Sambalpur, and steering committee members Prof. Janakarajan and Shripad Dharmadhikary of the Forum, with long experiences around the Cauvery and Narmada issues.

Following presentations by the centre on the research objective, methodology and findings of the action research, many issues and conflicts around Hirakud which had not been deliberated upon enough in the past, were discussed by the panel. Opinions about the process to be adopted for the study were expressed. While there was a consensus on the complexity and plurality of water conflicts around Hirakud, with

increasing dispossession of farmers, fishermen and the poor, there were different opinions regarding the need and process of attempting conflict resolution.

In the panel discussion, Lingaraj attributed the rise in conflicts since 2006 to large water intake by industries which had resulted in a shortage of water for agriculture. He felt that industries were not concerned about the problems of farmers. He was critical of the government which reduced the availability of water in the reservoir, but always claimed that there was enough water for industries and treated them preferentially compared to farmers. The large number of Memorandum of Understandings (MoUs) with industries being signed blindly by the government without measuring the water and sediment content in the reservoir, were a matter of serious concern for farmers. The conflict resolution mechanism adopted by the government was not very convincing. There was no hope for conflict resolution; instead, the protest had to be intensified as the government was playing double standards with the farmers to protect the industries. Lingaraj cautioned that the government's strategy of repairing canals and cutting off hydroelectricity production from 57% to 17% was not going to work. Such measures can give short term relief, but in the long run they would intensify the conflict. He also acknowledged that there are issues of water distribution in the Sason canal command area.

Ashok Pradhan pointed out that problems have occurred whenever water in the dam was at a level less than 630 ft (Full Reservoir Level). Such a situation has occurred 28 times since the dam was built. Siltation is another area of concern. Prof. Artabandhu Mishra considered Hirakud as a 57 year old mother and felt that we should not expect much milk from her, thus implying that Hirakud is an outdated and dying structure. Further, he said that the Hirakud dam not only created conflicts, but also destroyed forest and the microclimate of the area, devastated agricultural land and fisheries, and degraded the land and water quality. It caused deltaic destabilisation and coastal erosion. It engendered dependence on the system and infrastructure. In his opinion, the conflict cannot be resolved, but it can be prevented. Some people are promoting the conflict for political goals, which should be kept in mind.

Fishermen leader Gopinath Majhi described how fishing is being affected due to contamination. While earlier there were only two industries – Birla and Tata – using water from the reservoir, now there were nearly 30 industrial units using the water and polluting it. Construction of the Hirakud reservoir had displaced 26,500 families. Most displaced families settled around the peripheral region of the reservoir and resorted to fishing in it. Pisciculture has been affected due to water contamination, and the new reservoir fishery policy and the mismanagement of fishing lease allocations caused much adversity for fishermen.

Prof. D. P. Nayak said that the project was intended for flood control; other objectives were secondary. He predicted that the conflict would spread from Sambalpur to other districts such as Boudh, Sonepurand Bolangir. Puri, Bhubaneswar and Cuttack could also be affected. He said that hydroelectricity production had gone down because of the allocation of water to industries; supply to downstream cities was also being affected. With reducing rainfall and decreasing water levels, delta formation has started within the reservoir. He cautioned that the Sason canal would not receive the desired quantity of water, and the conflict would now be perennial. To get rid of these

problems, he suggested water harvesting and recycling by industries through captive storages and treatment plants, and renovation of all traditional water harvesting structures in the command area of Hirakud.

Prof. Janakarajan suggested an analytical understanding of the underlying issues and an approach towards negotiation by the stakeholders as the way forward. Pragmatic thinking towards the solution was required. The conflict should not be considered a negative development. Negative energy should be converted to positive energy. According to Shripad, farmers and industry cannot resolve the conflict through negotiations. Conflict resolution, he emphasised, should not be a compromise but should be equitable and just. All stakeholders cannot be treated equally, he felt, because stakeholders include victims and the privileged. He felt that the state centre should not side with any one stakeholder. He also felt that not enough attention is being paid to the quality of water in Hirakud. Tapan Padhi of the Odisha Water Forum suggested that the crop pattern be modernised and flood cushion provided. Modern technology should be applied to reduce the conflict. Prof. Chandan Mahanta said that the life of the reservoir is reducing and that there is a need to look for possible future trajectories. He suggested that the conflict can be solved through negotiations, and that industries should utilise corporate social responsibility (CSR) and company funds to develop their own water structures. Suhas Paranjape emphasised that knowledge systems should be created and validated.

The discussion about the Hirakud water conflict in this workshop was constructive and showed the way forward for working towards conflict resolution. It was decided that there would be no multi-stakeholder consultations with all the stakeholders. The consultations would be conducted separately with different stakeholders.

Consultations with Sambalpur Krushak Sanghatan at Maneswar Village

A one day farmer consultation workshop was organised by the state centre in Maneswar village of Sambalpur district on 13th October, 2011. More than 53 farmer leaders from around Sambalpur district participated. A brief presentation by the centre was followed by open discussion.

At the outset, Ashok Pradhan, Convener of the Western Odisha Farmers Coordination committee, took up the issues of the larger farmers' movement, government policy and law on paddy buying and selling, the Hirakud dam management issue, evaluation of loss of life and property due to recent floods, the Chakabandi (land consolidation) programme and the Sindol project. This was followed by a debate on drought and floods in which all the farmer leaders participated actively.

Saroj Mohanty said that the movement for water had just begun. The protest in 2006 was a historical movement. In the future, such protests would be more intense. The government had failed to fulfill the farmers' demands. There is no treaty between the Odisha and Chhattisgarh governments on the sharing of water and basin management of the Mahanadi river. Due to an erroneous decision by the government, the Bargarh district now faced floods, though it was unaffected by this natural calamity so far. No study has been carried out by the government to resolve the issue. Along with floods,

pollution has made the situation even worse. Fluoride contamination could affect paddy crops severely in the future. The land is already polluted by the release of industrial effluents. Using more fertilisers to protect paddy may finish off the crop altogether. The government owns most of the land in the peripheral region of the Hirakud reservoir now, with the surplus of acquired land in the possession of the Water Resources Department. In the near future, this land would be handed over to industries and corporate houses. He suggested organising a second phase of the protest movement primarily to demand a water sharing policy. According to Ashok Pradhan, though the irrigated area in the head region of the irrigation system has increased, it was not reflected as increased command area in government records. He demanded that the increased ayacut areas in the head region should be regulated. He also felt that there is an absence of dialogue between the Odisha and Chhattisgarh governments about water sharing and flood water release of the Mahanadi river. He highlighted that the renovation of the Sason canal system under the Accelerated Irrigation Benefit programme (AIBP) and its renovation by the state government after 2007 has not improved the irrigation system. There are many villages that are still unirrigated. During the construction of the dam, lift irrigation had been promised in Lakhanpur block and the Laira Tamperkela region of Sambalpur district. He further said that an increase in the water allocated to industries is a threat to agriculture. Therefore, a greater movement should be organised.

According to Bibhu Pattnaik, the mismanagement of Hirakud reservoir is a major reason for the recent flood situation and water conflicts in the region. There is need for a collective decision making process for reservoir operation management, in which farmer representatives should be allowed to participate. Further, he suggested that financial and institutional support to Pani Panchayats should be increased by the water resource department.

Murari Prasad Purohit, President of the Sambalpur Krushak Sanghatan, wanted issues of land consolidation in the command area to be resolved. There are irregularities related to land consolidation since 1986. As a result, there is no proper demarcation of irrigated areas, and increase in irrigated areas. Lack of proper land consolidations is leading to mismanagement in irrigation water distribution, renovation and reconstruction of the irrigation system, and collection of irrigation cess. He further said that water shortages in tail areas should be reduced through collective efforts with the active participation of farmer.

Farmer Consultation with Odisha Rajya Krushak Sanghatan, Bargarh

The second farmer consultation workshop was organised by the state centre at Attabira of Bargarh district on 22nd October, 2011. More than 50 farmer leaders around Bargarh district participated in the workshop.

Farmer leader Lingaraj emphasised the need for a dialogue between the Chhattisgarh and Odisha state governments on the construction of dams and barrages, industrial pollution, and flood water discharge from Chhattisgarh to the reservoir. Reservoir management should be participatory and collective, he emphasised. During construction of the reservoir, lift irrigation schemes were promised for the Bhatali,

Ambhaghona and Bijepur blocks of Barhgarh district. The state government should provide lift irrigation facilities as these areas are constantly affected by drought, he said. Most Pani Panchayats have been taken over by local contractors and powerful sections at the village levels. These institutions are unable to provide proper management of irrigation water in the command region. The tail areas are not getting water till date. There is an increase in the irrigated area beyond the designated command in head reaches of the canal system. The state government should regulate the increased command area in head areas. This will help towards managing the irrigation water, and supplying it to tail areas. According to the provisions of the Orissa Irrigation Act 1959, there should be first class irrigation in the command region of the Hirakud reservoir. However, there are cases where either there is an absence of irrigation water or second class irrigation water supply. The Water Resources Department should take up these issues and resolve them. It is important that farmers participate in the decision making process related to irrigation water management and reservoir operation management. Amitabh Patra, an activist from Bargarh district, highlighted sedimentation, reduction in the capacity of the reservoir, and the impact on water quality of the reservoir due to industrialisation, mining, and construction of dams in the upper catchment of the reservoir. He said that the farmers group from Bargarh is preparing to agitate against the ACC cement plant situated in the peripheral region of reservoir, which is dumping its mining overburden into the riverbed and reservoir. He also demanded a fresh study on fluoride contamination of the reservoir water. He said that during the floods in September 2011, there was crop loss wherever water entered the fields. This crop loss was due to the polluted water discharged by industries during floods.

Farmers felt that their situation could be improved by increasing the Minimum Support Price (MSP). Some responded that the MSP should be transformed into MXSP (Maximum Support Price). They said that the irrigation problem in tail areas cannot be solved by building cross bunds in the irrigation system. If there is demand for more water than that which the canal system can supply, the capacity of canals should be increased.

The farmers further said that the cropping pattern should be changed. However there are a number of issues such as irrigation management, marketing of other agricultural products, agricultural extension services and credit supply to the other farming practices which also require attention. They said that continuous flood irrigation for paddy has reduced productivity of our lands. There is a need for chemical fertilisers and pesticide doses to increase productivity. The farmer, being unable to pay for fertilisers and pesticides, is forced to take loans. Crop loss due to lack of irrigation water and erratic environment is leading to farmer suicides in the command region. Farmers are interested in changing the cropping pattern. However, the state government should ensure the participation of farmers in resolving issues related to farming practices in the command region.

Consultation with Fishermen at Lakhanpur

A consultation with fishing communities was organised at Pandri village in the Lakhanpur block of Jharsuguda district on 20th March, 2012. More than 50 fishermen from Bolanda village of Pandri gram panchayat participated in this consultation.

Following a presentation on fishery and issues related to the quality of water in the

reservoir by the centre, an open discussion among the participants was held. Some fishermen said that as per the new reservoir fishing policy of the state government, 2004, the fisheries department had assured fishermen that they would be provided different benefits such as boats, nets and other fishing equipment. These promises have not been kept. The fishing lease amount was earlier based on area rates on a per square kilometre basis, but after the new fishing policy was operationalised, the fishing lease has been worked out on a per hectare basis, with a high increase in annual royalty. Fishermen are against increased fishing lease and royalty. Fishermen felt that the new fishing policy was trying to limit the rights and scope of their cooperatives.

The institutional arrangements for fishing in the reservoir are based on fishermen cooperatives. However, according to the fishermen, they were not being adequately supported by these cooperatives. The storage, marketing and transport facilities were not there. Other support such as fishing boats, fish containers and nets are also not available through the cooperatives. The fishermen also complained about illegal fishing through small gauge and drag nets. Illegal fishing is carried out by powerful people from the region. The fishermen wanted to assert their rights to fishing in the reservoir, and demanded that illegal fishing in the reservoir be stopped.

The fishery department releases seeds of fishes in the reservoir at the start of the monsoon. The fishermen are however not informed about the varieties of seeds released. According to the new fishing policy, the fishery department is declaring a stoppage of fishing during the monsoon for proper growth of fishes in the reservoir. The fishermen partly agreed with the department regarding this stoppage; however, they also sought alternate livelihood options during the monsoon period. They are demanding proper support from the fisheries department before the implementation of the stoppage in the reservoir.

The fishermen are concerned about the gradual reduction in fish production in the last ten years. However, there is a sharp reduction in the last 3 – 4 years. According to them, there is more than 50% reduction in fish production. With this decrease in fish production, the varieties of fish have rapidly reduced. At present, there are nearly ten varieties which comprise most of the fish catch, and another 30 varieties present in small proportions. According to the fishermen, there were different local varieties in the reservoir in good numbers, which have disappeared or are present in very small numbers.

The fishermen attributed the reduction in fish production and varieties to heavy industrialisation around the reservoir. After 1991, many minerals and thermal power based industrial units started to come up around the reservoir. The Ib valley coalfield of Mahanadi Coalfield Ltd is in the peripheral region of the reservoir. Fishermen are finding a black layer on the reservoir water due to the discharge of untreated effluents from industrial units and mines into the reservoir. Fly ash from ash ponds is being directly deposited on the surface of the reservoir. Most small fish are dying due to the consumption of fly ash. According to the fishermen, dead fish are more commonly observed now. The numbers of dead fish increase during the beginning of the winter season, when fish larvae grow. Reservoir water pollution is a major concern for fishermen which is directly affecting the water quality and livelihoods of the fishermen community. Fishermen are against reservoir water pollution due to direct untreated industrial effluents discharge. They are demanding that industries should not discharge their untreated effluents into the reservoir.

11 Chapter 11
Conclusions and Recommendations

Action Research Findings

Increasing Inability to Control Floods and Emerging Conflicts

The Hirakud dam was conceptualised by the colonial regime during the flood investigation process in the colonial period. The rise of protectionism and the building of embankments in the Mahanadi delta had resulted in devastating flood damage. The inability of embankments to save lands in the delta region gave rise to the concept of constructing storage reservoirs on the Mahanadi river to protect the delta region. The idea of constructing a storage reservoir later expanded into a multipurpose river valley project in the wave of post-independence developmentalism.

The planners of Hirakud had estimated that the capacity of the dam would be sufficient to control floods in the Mahanadi river. However, half a century after its construction, it seems that it has failed to control floods as shown by the peak flow figures at Mundali and flood damage in the delta in terms of area, life and property affected. The media, civil society and alternate discourses have converged time and again to question Hirakud's ability to control floods, and have attributed the failure to the ineffectiveness of reservoir capacity coupled with its reduced storage capacity and non-compliance of the reservoir operation with the 'rule curve' in order to accommodate industrial and power production needs at the cost of flood control. However, some from the engineering fraternity and protagonists of the dam attribute this failure to the lack of implementation of a basin-wide approach, and delay in construction of storage structures in the lower tributaries. Whatever the arguments, Hirakud seems to have failed in controlling deltaic floods and the resultant damage, which was the primary reason for its construction. As it ages and loses capacity, as climate change takes place and there is an increase in the pace of economic development and consequent emphasis on industry, the effectiveness of the Hirakud dam in controlling floods is dwindling day by day, which threatens to accentuate the woes of Odisha and conflicts around floods.

Conflicts around Hirakud: Not Industry vs Agriculture Alone

Water conflicts around Hirakud are not limited to floods and the industry vs agriculture conflict. Right from its conception, it has been mired in conflicts. The announcement of the construction of the Hirakud dam resurrected the issues of regionalism in western Odisha. There were intense protests in Sambalpur over the threatened submergence of poor West Odisha villages to save the prosperous coastal delta from floods. The local communities felt so threatened that they demanded the separation of Sambalpur

from the rest of Odisha. Though this conflict fizzled out later due to various reasons, after the dam was constructed, another bout of conflicts began over the issue of compensation and rehabilitation of the people displaced by the dam, which has not been completely addressed till date. They have been suffering even after 50 years, as Nehru had urged them to do in the interest of the country. None of the resettlement colonies has benefitted from canal irrigation, neither were they provided lift irrigation as promised. Twenty-one resettlement villages lack revenue status, and only in 2011 has the government assured the villagers that land rights would be settled in their favour.

After the construction of the dam, the displaced people had no options to earn a livelihood, and resorted to fishing in the reservoir. However, their livelihoods are still not assured, and they struggle for fishing rights in the reservoir to save fish biodiversity and population from increased water pollution and illegal fishing in the reservoir.

The drawing of water by industries from the reservoir resulted in a conflict between industry and agriculture during 2005-07. At its peak, this conflict brought forth an unprecedented mass mobilisation and rocked the state's power centre and assembly. What was very important in this conflict was the coming together of farmers' movements of western Odisha, political patronisation of the farmers by the Congress party, support from anti-industrialisation movements, and the solidarity of the local media and civil society.

The establishment of an increasing number of thermal and aluminium industries in the Sambalpur - Jharsuguda region has led to an increased environmental burden on the Hirakud reservoir, due to the severe pollution by effluents and dumping of fly ash in the rivers Ib and Bheden which drain into the reservoir. Farmers and fishermen have alleged that their livelihoods are threatened by this pollution, and their organisations and movements have been protesting against it.

The command area of Hirakud is also fraught with conflicts, mostly related to water distribution and availability between different reaches and groups. Tail ender deprivation is common and has resulted in conflict among the farmers from head and tail reaches. Water conflicts in the command area are increasing due to the lack of proper irrigation infrastructure, monocropping of paddy, lack of land reforms, and consolidation and increase in the non-command area under irrigation. The command area is also suffering from the industrial pollution of the air, water and soil. Farmers feel that crop loss in the command area is due to the polluted reservoir water supply for irrigation.

Changing Catchment Conditions Exacerbate Conflicts

Over 90% of Hirakud's catchment area lies in Chhattisgarh. Post-Hirakud, a surge in damming activities has intercepted 24% of the total catchment of the Hirakud reservoir, and reduced the inflow by an estimated 5% per decade. During the construction of the Hirakud dam, there was no agreement with Madhya Pradesh related to the sharing of waters of the Mahanadi river. The changed rainfall and runoff pattern due to climate change, development of new irrigation projects, catchment

treatment through watershed projects, increase in water demand and utilisation for irrigation, drinking and industrialisation are affecting water availability in Hirakud. Land development activities, mining, heavy industrialisation and deforestation are increasing the silt load in the dam. Effluents discharged by industries in the upper catchment are directly entering the reservoir. The fly ash from most thermal power plants in the upper catchment is adding to the rapid silting up of the reservoir.

Dam projects in the upper catchment are constructed for irrigation purposes, without flood cushioning. During floods, coordination with the Chhattisgarh government is vital to assess the incoming water flow into the reservoir. In inter-state and dammed rivers, dams in the upstream are required to share information about water release with downstream dams to enable them to control their reservoir operations. However, in the absence of any agreement between Chhattisgarh and Odisha, such sharing of information has remained largely voluntary. Sudden releases from these dams during heavy rainfall spells in Chhattisgarh are now resulting in high peaking inflows into Hirakud, putting dam management into an emergency situation without advance notice, a phenomenon which was not seen earlier. The reference point for the present reservoir operation is the Rule Curve developed in 1988, which is based on an analysis of past inflows. However, since then, the catchment in Chhattisgarh as well as Odisha has undergone massive changes, which has significantly affected inflow peaks and patterns, which the rule curve is not designed to handle.

Increasing Siltation Adds to the Conflict

The live storage of the Hirakud dam is only 8% of the average annual run off into Hirakud, so a reduction in its storage capacity severely affects its flood moderation capacity. To maintain reservoir capacity, the project report of Hirakud had estimated that silt deposition in the dam should not exceed 8% of the annual silt yield. Provision of deep sluice gates with flood discharge capacity of 7 lakh cusec of water was expected to remove the entire suspended silt, and to a large extent, the coarse silt from the reservoir. Though there have been conflicting reports on the extent of sedimentation cutting into the live storage in Hirakud, there is enough evidence and consensus that a considerably larger reduction in storage space than was estimated has taken place. The monsoon runoff is now reduced by 12% (it has come down from 26.5 million acre-feet (MAF) in the pre-Rule Curve period to 23.4 MAF in the post-Rule Curve period). The reservoir capacity has also reduced. There has been a reduction of 28% in the storage at 630 ft Reservoir Level (RL) (1.82 MAF reduction, from 6.6 MAF to 4.8 MAF) and 52% at 590 ft RL (1.01 MAF reduction; from 1.88 MAF to 0.87 MAF) due to siltation.

The main reason for building the dam, though, was to control floods in the mighty Mahanadi. With a limited storage capacity (8% of inflow), flood control relied on strategic reservoir operations (rule curve) to control floods in the monsoon period, and ensure water availability for irrigation and power generation in the lean period.

The present reservoir operations, which are carried out according to the rule curve of 1988, increasingly pose a challenge as multiple demands have to be met.

Multiplying Problems of Multipurpose Operation

The Hirakud dam project was conceived as a multipurpose river valley project, with provisions to supply water for irrigation, power generation, drinking water, navigation and fishery. There was no industrial water allocation in the initial plan, though a handful of industrial units were drawing water from the reservoir. Hydropower generation was the major priority in the project report of 1952, and also the key driver for reservoir operation till 1991. However, since then, problems have been on an increase.

Over time, there has been a change in the ayacut as well as the crop pattern, both departing significantly from what was designed. As per different statistics, the direct irrigation provision from the reservoir in 2007 was about 50% of the area promised in the project report (including lift irrigation). On the one hand, according to media reports, the original demarcated command area of 25,567 ha of the Sason canal and Sambalpur distributaries has now shrunk to 17,199 ha. On the other hand, in 2007, the Kharif and Rabi paddy coverage were 98% and 70% of the ayacut as against the prescribed 70% and 33% respectively in the project report. The Rabi paddy area coverage in the Hirakud system is the highest for any command in India.

The industrial water use and allocation was nominal till 1991. Post 1991, in the reform era, water allocation and use for industrial purposes has started increasing and is poised to increase considerably with the impeding entry of a number of alumina and power plants with their massive water needs. Though irrigation and power generation still account for a major chunk in allocation from the reservoir, seasonal availability of water is resulting in an intense competition among water users in the lean season. Initial priorities are giving way rapidly to favouring industry because they can pay more for the water, and have more power and influence than the other water users.

Downstream flow from the Hirakud dam is important for environmental purposes, but is dependent on the reservoir operations policy, especially, on the quantum and pattern of hydropower generation, which has also been affected by the increasing diversion to industry as well as for drinking water. However, even though the state government emphasises that the irrigation potential of Hirakud would not be reduced if water up to 0.350 MAF/year is provided to industries, it does admit that power generation would be affected during the non-monsoon period, and that by implication would affect the downstream riparian environment. The results are now apparent. The Mahanadi has now already been categorised as “strongly affected” by flow fragmentation and regulation.

Pollution adds to all these factors. The direct discharge of untreated effluents by a growing number of industries around the dam (in the Sambalpur - Jharsuguda region) into the reservoir or the streams feeding it is degrading water quality and making the water unsuitable for drinking. Degradation of water quality is directly affecting aquatic biodiversity and fishing in the reservoir and it’s downstream. There is a sharp reduction in the number of fish varieties and fish production in the Hirakud dam. The livelihood of fishermen is threatened. Drinking water supply, which is also a mandate of reservoir management, is being affected during the lean period as well as due to deteriorating water quality.

The present trends can be seen to be clearly causing an intensification of conflicts around the Hirakud dam. With changes in rainfall pattern, runoff, reservoir capacity and priorities as well as with the availability of better technology and options, there is a growing need for adopting more adaptable, reliable and inclusive approaches towards reservoir operations. However, there is a tendency in research and academic literature to make recommendations aimed more at efficiency and economics rather than the issues of the poor and the environment. If conflicts are to be avoided, it is important that the priorities of the poor (drinking and water for livelihoods viz. irrigation) and environment (e-flow) are integrated suitably to address issues of equity and justice.

Low Water Efficiency and Ineffective Institutions

Though there have been disagreements about the extent of the benefit, irrigation in western and coastal Odisha has been the most visible benefit from the Hirakud reservoir. There is a significant increase in the irrigated area in villages situated in the head reach of the command area, which includes unauthorised conversion of village forests and pastures. Irrigation management in the Hirakud command has been blamed for several problems plaguing the command area: problems of waterlogging, reduction in agricultural production, seepage and leakage, monocropping, and conflicts around water distribution. While the irrigated area is increasing in the head reach of the irrigation system, it is decreasing in the tail end areas. The low irrigation efficiency in the Hirakud command is largely due to limitations of irrigation infrastructure (faulty laying of canals without survey, unlined canal system without field channels, exclusion of traditional water bodies, provision of cross-bunds etc.), and irrigation institutions (lack of land consolidation, irrigation cess, lack of empowerment of Pani Panchayats, etc.) and crop planning and management (overemphasis on paddy monocropping, overuse of chemical fertilisers and pesticides , lack of conjunctive use, market influence on crop choice, etc.). There are also instances of crop loss in the command due to pollution during floods. These issues are now leading to farmers' suicides in the command area, which was unheard of a few years back.

Move towards Economics and Efficiency, or Commodification of Water?

In the reform era, Odisha has been trying to use its rich natural resources including water for faster industrial development through direct foreign investment and externally induced sectoral and institutional reforms. Public investments have been substantial in the areas of developing water resource facilities. This has triggered contestation between the environment and development, as well as between equity and growth. The changing water policy scenario in Odisha has significantly influenced reservoir operations and management. The post-1991 reforms have been legitimising state-mediated appropriation of reservoir water by economic interests. A conspicuous example is compromising hydropower generation from the reservoir, which was earlier a major priority, in order to favour industrial allocation. All the intensive studies and planning around the state's water resources and river system (viz. spiral studies), and the Integrated Water Resources Management (IWRM) road map, have led to easier commoditisation of water in the name of efficiency and more economic use of water. Increased availability of information about water has also catalysed the entry and colonisation of water rich areas like the Hirakud reservoir by the industry and market.

Legal frameworks and policies around interstate water sharing, rehabilitation and resettlement have also influenced conflicts around Hirakud. While there has been growing realisation for the need for an agreement over the Mahanadi between Chhattisgarh and Odisha over information and water sharing, changes in the resettlement and rehabilitation (R & R) policy have also positively affected the displaced from Hirakud of late. The prioritisation of water allocation in the State Water Policy, 2007 also seems to have been influenced by the industry vs agriculture conflict, recognising the priority of environmental flows, as well as agriculture, though it often remains only on paper and is violated during actual reservoir water allocation.

While pollution in and around Hirakud has been accepted as a major problem, even by the State Pollution Control Board, nothing substantial in terms of policy prescribed deterrents has been done. However, recently after the flood related pollution and crop loss in 2011, on the instance of the Human Rights Commission, the superintendent engineer of the Hirakud dam project has requested the Pollution Control Board to carry out tests on the reservoir water and ascertain if it contains anything hazardous to cultivation.

Stakeholder Analysis

Apart from an understanding of causative factors, resolving conflict is incumbent upon the delineation and analysis of stakeholders. The conflicts around the Hirakud reservoir, though influenced by economics and geography, are also shaped by history and politics. These conflicts have strong historical roots, particularly in the history of regional movements. The conception of the dam had seen intense protests. Non-judicious distribution of benefits and compensation to displaced people led to movements by the displaced people after dam construction. The apprehension that reservoir water would be colonised by extractive industries, along with the growing unrest around regional disparities and backwardness, led citizens from the region to rally behind the farmers, making the agriculture vs industry water conflict a regional issue.

The industry vs agriculture water conflict led to the formation of an informal yet strong stakeholder alliance of environmentalists, academicians, citizens' forums and media who stood behind the farmer and fishermen groups. They were able to pressurise the state government to make decisions in their favour, at least at the level of announcing policies. However, the industrial stakeholders have been influencing the government strategically behind closed doors, and have managed to get continuous water supply from the reservoir without being penalised for the pollution they are causing. They have argued for a share of the water based on their contribution to economic development, and the policies and reform processes of the state favouring industry. The state government and the Hirakud dam authorities are trying to maintain a balance between water supply for industries and agriculture, as both have the power to influence the state government. Political representatives are interested in protecting their politico-economic interests in this conflict. The different government departments and agencies dealing with water (the Water Resources Department, Revenue Department and Agriculture Department) lack coordination and have not been able to moderate the conflict. Newly formed Pani Panchayats are unable to exercise their powers due to the lack of orientation and support.

There is considerable stratification among various stakeholder groups, which yield different levels of power. The power structure among farmer groups influences decision making related to irrigation water. Vulnerability among farmer groups is increasing with time. Tenants and sharecroppers, who are in large numbers due to hidden landlordism, lack social security and are major victims of irrigation water shortages. Similarly, it is the small industries which suffer from water shortages during the lean period, as they lack direct access to the reservoir and have less power to influence authorities. The fishermen are facing loss of fish production due to fly ash contamination and water pollution, and are lobbying hard with the government.

Though there are many stakeholders who have been adversely affected, these stakeholder groups have not come together. There is an absence of any dialogue process among the stakeholders. The farmer unions and government bodies are also unable to come together for working towards resolving the conflicts.

Stakeholder Dialogue

Open, continuing and patient dialogue among stakeholders is very important for an acceptable and just conflict resolution. Right at the start, it was clear that positions taken by the adversely affected stakeholder groups were strong, and that there was no willingness to sit at a common table. Considering the strong convictions of stakeholders and their adopted stands, it was decided to have consultations with the stakeholder groups separately. The state centre's conflict analysis along with a broader picture of issues influencing the conflict directly and indirectly was shared with the stakeholder groups, and they were asked to provide feedback for a multi-stakeholder dialogue. Along with interactions with farmers and fishermen, different meetings with the representatives of various stakeholders groups were also organised as part of its consultation process, using platforms of workshops and events.

In the consultation with senior citizens and opinion makers, it was felt that they believed that Hirakud should not be viewed as a minor water conflict. They saw it as part of a larger conflict around mining, dams, and the appropriation of natural and other resources from the people. They felt that because the government was siding with the industries, it was a virtual war between the people and industries, and there was little scope for a dialogue. Therefore, they believed, the civil society should support the people. While some members blamed insufficient water (reduction in inflow) in the reservoir and the growing allocation to industries as the real cause of the conflict, others felt that faulty reservoir operations and inappropriate water distribution, management and cropping were also issues which could not be overlooked.

Movement leaders feel that the role played by the government in conflict resolution was not very convincing and that the government is playing into the hands of industries, and therefore should not be trusted. They were also concerned about the overall performance failure of the dam, and the prioritised treatment to industries. They felt that the conflict can be prevented, but that one should be wary of people in charge who often promoted conflicts for political gains. They also conceded the importance of technical measures like water harvesting and recycling by industries through captive storages and treatment plants, and renovation of all traditional water harvesting structures in the command area of Hirakud. However, they felt that the

outcome should not be a compromise, but instead should be an equitable and just solution.

In the farmers' consultations, it was suggested that a second phase of the protest movement be organised for the establishment of a water sharing policy in Hirakud. There was a demand for dialogue between Odisha and Chhattisgarh governments about water sharing and flood water release from the Mahanadi river. Highlighting industrial water use as a threat to agriculture, they wanted rationalisation and consolidation of command area irrigation (between head and tail and land consolidation), empowerment of Pani Panchayats, and the initiation of lift irrigation, as promised in the original Hirakud proposal. They wanted a collective decision making process for reservoir operation and irrigation management, with participation of farmer representatives. On the pollution of the reservoir through effluents and dumping of fly ash and mine overburden, they wanted a thorough study, analysis and action, and threatened protests if required. They also wanted to have the maximum support price for paddy, increased conveyance capacity of the canals, and government support to improve efficiency through water efficient cropping patterns.

During consultations with fishermen, it was learnt that they wanted to assert their right to fishing in the reservoir. They demanded the stoppage of illegal fishing in the reservoir, more support from cooperatives, alternate livelihood options during fishing closures, and prevention of discharge of untreated effluents and dumping of fly ash by industries into the reservoir.

Conclusions and Recommendations

One of the key points that emerged from this action research is the need to understand the Hirakud conflict beyond the 'Industry vs Agriculture' framework, and accommodate other complex issues and conflicts related to equity and justice around the dam. There are many intra-sectoral and inter-sectoral water conflicts around Hirakud. Hirakud also presents a classic contestation over natural resources in fast-developing countries, that between neoliberal economy pushing the market and reforms, and local communities struggling to maintain their livelihoods and institutions. The situation exemplifies the global debate around water and environmental justice. There is a need for a comprehensive and holistic appreciation of these complex issues by the stakeholders to develop 'convergence spaces' for strengthening alternate discourses on dams and reservoir management, and for contributing towards conflict resolution mechanisms.

During the course of the action research, a great deal of information disconnects and divides were visible among and across stakeholders. Most of the hydro-meteorological as well as historical information about Hirakud is not easily accessible. Over the years, activists, academicians and journalists have proffered some analytical information and theories about the conflict, its causalities and a few solutions. More information and theories are available about causalities than about solutions.

Most of these theories have taken the shape of particular narratives and discourses, which seem to have been going around and influencing perceptions of stakeholders, particularly those who have limited access to the right information and thereby quite often intensify an alienated view. Even news propagated by media at times lacks right

and/or complete information. There is a strong need for transparent information sharing related to quality, availability and allocation of water from the reservoir. Though debates and dialogues are intrinsic to a democracy, they can become more meaningful with the right information, and a basis for conflict resolution, if the information constitutes a shared and valid pool. It is suggested that the formation of such a shared and commonly validated pool of information would be an important step towards conflict resolution.

The study also realised through a series of stakeholder consultations that while there was a consensus on the complexity and plurality of water conflicts around Hirakud and increasing dispossession of farmers, fishermen and the poor, there were diverse opinions regarding the need and process of attempting conflict resolution. Specifically, the movement leaders, who are the key agents for dialogue, seem to lack faith in the government or industry, and consequently have even less faith in conflict resolution mechanisms. Attention must be paid to the fact that they strongly feel that the government acts as an agent for the industry, instead of acting as a custodian of public good. The government needs to realise that its attempts to gain trust through sops and offers will not work unless it is seen to act against the blatant violation of rules and norms by the industry. The industry should also come to this realisation. Only then can the preconditions for a rational dialogue be set up.

Setting Norms for Conflict Resolution

In stakeholder consultations, it was apparent that different groups were mobilising different normative frameworks in expressing their views on the conflict. This indicates the need for a social consensus around the broad framework of norms which can frame a common dialogue. Such a framework should be identified based on ethics, the law of the land, and acceptability among stakeholders, and should consist of the minimum non-negotiable norms based on the principles of justice, equity, sustainability, livelihoods, participation and cultural identity. Based on policy prescriptions, a clear guideline for allocation priorities under different situations as per past experience and simulation models can facilitate transparent decision making. These norms can be developed in a multi-stakeholder consultation and widely disseminated among stakeholders to allow feedback. A simple and small normative document can also facilitate wider and inclusive consultation.

Inclusive Institutional Platform for Multi-stakeholder Interaction and Action

There is a lack of information flow and perception across stakeholder groups, except among movements of farmers, fishermen and displaced people. This has led to the inbreeding of theories, information and perceptions within groups, and a growing mistrust of those who are not part of the group, curtailing the scope of coming together or even discussing options other than their own, let alone having a dialogue on conflict resolution. There is a need to sit together and listen to each other.

A multi-stakeholder forum around the Hirakud dam could be formed by representatives of key stakeholders, nominated by the stakeholder bodies (viz. farmers'/fishers'/ displaced peoples' movements, Pani Panchayats, industries, citizen forums,

government departments, elected representatives, civil society etc.). It could be constituted of people who are credible, acceptable to the stakeholders at large, and are open for dialogue. They should also be willing to recommend action and participate in monitoring the action taken based on their suggestions. They should meet regularly, exchange and verify information, and facilitate communication with their stakeholder groups.

Enhanced Access to Right Information on Time

Availability, allocation and utilisation of water in Hirakud are governed by complex interactions of fast changing geo-political, hydro-meteorological and socio-economic contexts with multiple stakeholders across its catchment, reservoir and command. Information generated in the process is huge and complex, and should be available and accessible in the right form to different stakeholders in order to help them make right decisions. Enhanced access to right information can lead to informed choices by the stakeholders. Information related to conflicts, particularly the causalities, is often not easily available (for example, inflow and outflow data from the reservoir, rainfall data). Even if it is available, quite often its reliability is difficult to verify (for example, quantity of water released from the dam to the canal or during flood, amount of water allocated to and taken by industries or agriculture). Even where it is reliable, very often it remains extremely complex and needs to be interpreted (for example, rule curve, quantity of water release by Hirakud and flood intensity during flood, concentration of pollutants).

Since the last few years, the Water Resources Department of the Government of Odisha, has been sharing a lot of information about industrial allocation, floods, reservoir level, releases, etc. on their website. Some information is even updated daily, particularly the flood bulletins during floods, which is a good beginning. However, there is a need to develop an information interface (something like a Citizens Water Portal of the state) in partnership with civil society to put together all such information (and discussions) in one place, simplify it and interpret it further, so that it will lead to a better understanding for different stakeholders. It is expected that with such enhancement of access to the right kind of information, stakeholders will be able to make better decisions, which will eventually help in preventing and resolving conflicts. An informed and inclusive decision on water resources will also go a long way towards equity, justice and sustainability.

Innovation: Thinking Out of the Box

Every stakeholder group has its own solution to the Hirakud conflict, and quite often, the solution offered by one group is not acceptable to another (for example, cancelling all the Memorandum of Understanding (MoUs) with industries which allocate Hirakud water to them; or decreasing cropping intensity in Rabi and abandoning paddy-paddy-paddy triple cropping). However, there are some innovative technical or institutional solutions which may find acceptance from or at least appeal to more stakeholder groups (for example, water harvesting by industries, increasing water use efficiency in agriculture through conjunctive use). What is required is innovative thinking out of the box which will result in minimising the area of contention, and in the best possible scenario, lead to a win-win solution.

Table 11.1: Recommendation Matrix along Dam's Conflict Geography

Conflict geography	Policy level	Implementation level
The Catchment	Interstate agreement on the sharing of Mahanadi waters between Chhattisgarh and Odisha, with a clause on pollution monitoring and control. Until it is reached and operationalised, regular information sharing mechanism and coordination among dam management	Multi-stakeholder investigation into illegal water withdrawal and pollution in the Ib and Bheden, and recommendation to the government as per the existing legal framework
Reservoir and its surroundings	Re-assessment of providing irrigation to Rengali and Lakhanpur blocks through lift irrigation/MIP Make reservoir management decisions transparent and inclusive Moratorium on the release of untreated effluents into the Hirakud reservoir Fishing right to local fishing communities who were affected or displaced by the dam	OPCB authority may constitute community auditors to observe and report. Return of the additional land (between 630-632 RL) taken by the government for the reservoir to the oustees, and a declaration of the colony of 21 displaced villages as revenue villages Water prints of industries need to be analysed, documented and widely disseminated and debated. Industry must harvest, recycle and reuse water to meet a certain percentage of the demand. A Hirakud Development Fund can be created from Corporate Social Responsibility funds of industries to be utilised under the administration of a multi-stakeholder forum to address issues of equity and justice, and help pilot action research
Command Area	Revisiting land reforms and land consolidation in the Hirakud command Enhancing rights of landless, tenants and share croppers Democratisation of Pani Panchayats through inclusive participation, especially of active farming households which may include the landless, tenants and sharecroppers Incentivising the use of water saving and water use efficiency enhancing practices/technology by farmers	Making irrigation management in the command transparent and inclusive through an apex body of Pani Panchayats which should work in coordination Addressing head tail issues (viz. cross bunds, water sharing, etc.) through an empowered apex Pani Panchayat Better coordination between agriculture and water resources department Renovation of the canal system along with laying of field channels and all traditional WHS Provision of marketing support/MSP for non-paddy crops Piloting participatory action research for increasing water use efficiency at the farmer and village levels

Key Recommendations

Revisiting Promises Made

During construction of Hirakud and after, many promises were made by authorities, either as a damage control exercise or with an honest intention to ensure equity and

justice. Some of these promises were lift irrigation in the peripheral region, allowing fishing from the reservoir by the resettled oustees, and irrigation in the command area. However, due to political compulsions, vested interests, or the influence of neoliberalism, many such decisions have not been implemented in the name of efficiency, availability of funds, etc. This has led to escalating dissent, alienation of many stakeholders, and has fuelled conflict and conflict-like situations. There is a need to systematically revisit these decisions, consult all relevant stakeholders, and through a multi-stakeholder consultation, review earlier decisions and their implementation, keeping equity and justice at par if not above economic and efficiency considerations.

Making Reservoir Management Inclusive and Accountable

Mending Disconnected Decision Making

Assumptions based on scientific interventions / hydrological modelling often influence water resource management and decision making. Such decision making is quite difficult to understand for most users and stakeholders. Many times, such decisions are also implicitly based on questionable judgements (preferring power production over flood cushioning or vice versa), vested interests (non-transparent decision making in favour of particular parties), or implicit value assumptions (all water flowing to the sea is a waste and needs to be dammed). In any case, such decision making is always far from being inclusive. Quite often, it also lacks sensitivity to local political and cultural sensibilities, and consideration of the issues of equity and justice with respect to local communities and stakeholders in favour of quantifiable norms (rule curve formation, priority setting, dependable flows and their analysis). Participatory and transparent democratic governance is important in conflict resolution and avoidance, particularly so for natural resources. It is important to shift to an inclusive and transparent decision making process which is accountable to stakeholders.

Inclusive Implementation

Implementation of most reservoir management decisions is also hardly inclusive and effective, often raising questions of their reliability and fairness. The data collection, analysis and dissemination of reservoir information should be carried out with community participation. The people should have access to information, and should be able to participate in making decisions and monitoring implementation. This will help to reduce conflicts around water related to the Hirakud reservoir.

For example, as the experience of the last flood indicates, changes in the catchment in Chhattisgarh and its reservoir operations need to be integrated into the ‘rule curve’ operation. However, besides a formal arrangement between the two states, the involvement of civil society and basin stakeholders in such a process should be mandatory for inclusive and transparent decision making and implementation.

Adapting Reservoir Operation to the Changing Context: Options and Risks

There is a need to modify reservoir operations to adapt to changes in stream flow patterns. It is necessary to emphasise that the reservoir operation rules should be

soundly adapted to global climate change as well as hydrological changes and economic activities in the river basin as a whole. Modelling options suggesting trade-offs between irrigation, flood control and power generation to rationalise reservoir operation in the changing economic and climatic contexts are also being recommended.

However, one also needs to take note of the fact that dams are becoming testing grounds for utilising hydrological research and modelling aimed at precision forecasting of water availability and demand to enable liberalisation privatisation globalisation (LPG) dictated 'rational' reservoir operations for maximising economic gains in the neoliberal era. Higher predictability of hydrological behaviour will also facilitate commodification of water and make it easier for markets to trade water, and hydropower and industrial use may be prioritised at the cost of flood control and irrigation. If this happens, it will become the source of a new set of water conflicts. This is one of the reasons for which the final rule curve should be arrived at in an inclusive and participatory manner.

Piloting Action Research

None of the measures outlined above will work if we do not increase efficiency and economic gain without sacrificing equity, justice or sustainability. This involves a transformation in the way we use water, what crops we grow, and the institutions we craft around it. There is a need to reassess the water requirement for agriculture, fisheries, and other livelihood purposes in the Hirakud command under different livelihood options. There is also a need to widely disseminate water efficient and environment friendly livelihood options, and this information should be made available publicly.

Based on water available and related information, a water use plan should be evolved for agriculture and fisheries with the most effective water use based on the principles of food security and equity. Through regular interaction before every crop season between different users such as farmers, fishermen and officials, the plan could be synchronised as per water availability, lean period, lean season, etc. Priority must be fixed as per the present water policy in the allocation of water during cropping season will be made. Community monitors representing stakeholders should monitor the water use, and changes in water uses and allocation should be shared transparently and regularly. Accordingly, water allocation from the reservoir through different outlets as well as their release to the user site should be monitored.

This is only an outline of what has come out from our action research study. The real challenge lies ahead. What is required is a pilot action research undertaken along these lines. Such a pilot would need to cover not only the technical aspects of water saving but also the institutional mechanisms necessary to bring different water users together to develop and implement a commonly agreed upon plan for the utilisation of water from the Hirakud dam.

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