Photographs from the starting phase of Assabol Dam in 1997. Blasting works for the gorge access, setting up and the site of the gorge access, searching for best dam site with the help of iron bars, excavating the foundation and boulder breaking, access works, and casting of foundations.

Blasting expert Reini Schrämli and civil engineer Urs Schaffner. Meeting point of the two main contributing rivers at Asmuth during rainy season, various landscapes of the upper watershed.

Photographs from the start of dam raise, from the foundation to 5 meter height in 2002. Works often exposed to flooding. In the beginning, concrete mixing and aggregate accumulation was done directly on the dam, what prohibited work during rainy times.

Dieter Nussbaum, Caritas Switzerland, Endrias Gebray and Bruno Strebel, plus Abba Hagos Woldu with Wolde Chairman Gebreh. View towards gorge Assabol, Dawhan during river flood, and four photos from upper watershed landscape.

The larger photo shows the Assabol (means Red Cliff) and Kinkintay (means Ringing Stone) mountains from the downstream side. In the centre the gorge with the dam lies. These two rock outcrops are part of a geological ring dike of very hard quartzporphy rock, what provided perfect dam site conditions.
Assabol dam construction from 2003 until 2004: Collection of sand and gravel, boat access, hose siphoning, first experiences with heavy sediment loads. In 2005 the dam steadily grew thanks to flood secured concrete casting by now well functioning cable crane. Intake pipes were laid and sluice gate conduct was constructed.

Members of the crew enjoy the visit of the Bishop of Adigrat, who has always shown great personal interest in the undertaking. Also the visit of Karl Wehrle is depicted. Pipeline on cable span at Kitra, and check dams in the upper river. One larger photo shows the first gardens to be irrigated

Assabol mason crew with portraits from guard Mesghenna und jackhammer king Teum, plus irrigation engineer Halifon. The sedimentation behind the dam varies from mud to sand and gravel.
Preface

In the years of the great drought of 1973-75, the immense poverty of Northern Ethiopia was revealed to the world public for the first time. Massive international food aid saved about one million Ethiopians from starving to death. At that time, Caritas Switzerland in cooperation with the Catholic Church initiated an emergency aid campaign that intentionally relied on the people’s own capabilities. Humanitarian aid was coordinated with labour-intensive operations for the ecological soil conservation. Over the years, more than 800,000 square meters of rock were quarried and transported, and piled up to thousands of dry stonewalls and hillside terraces. These walls and terraces helped to hold back the sediments during the rainfalls, making new pastures and fields available for cultivation. New roads and tracks were built across the land, and hundreds of new wells were installed. It was the start of a dream. Flowers should bloom in the stony desert, and the people who are living in it should be prevented from starvation. It was in those years that the idea of a dam on the main river was born.

Caritas Switzerland was more than open to this idea. Living in a very mountainous country as well, Swiss people are well acquainted with multiple and innovative use of waterpower. We sympathise with the people of the Tigray and the challenges posed to them by the landscape. The Catholic Church of Northern Ethiopia has proven to be a partner organisation with visions and courageous people who venture to implement seemingly impossible projects under the most adverse conditions. The path we walked together was difficult and stony indeed, in the truest sense of the word. There were numerous obstacles, ups and downs. Drought and hunger have remained serious problems in the Irob woreda. The chaos of the wars in the 1980’s and 1990’s has impeded the work on the dam for several years. The vision and mission shared by both organisations have turned out to be a reliable guide for our cooperation: Serving the process of sustainable development for the benefit of the economically marginalised rural population.

The opening of the Assabol dam marks the peak of our long-standing cooperation and partnership. We can now see its result with pride and contentment. The valley above and below the dam is a green strip amidst the dry and rocky landscape of Irob country. The impressive dam, each piece of it piled up by human hand, can now be put into operation. It opens up new opportunities for food security and water supply of the people of the Irob woreda. With its height of 42 m it is a structure outstanding for Ethiopian standards. I am happy to see that after seven years of construction work, the Assabol dam is now completed and ready to be opened.
View to Assabol from the new Catholic church of Dawhan; on the right side you see Dawhan and in front the office of ADDA.
Can Dreams Become a Reality?

Dreams

Dreams! Dreams! Dreams!
To dream is easy, but to turn a dream into a reality may often be beyond practical expectations. Nightmares, however, may give birth to the dreams. How could the people living to the east of Adigrat on the steep slopes of the Rift Valley be saved from repeated droughts and hunger? How could those people be provided with a minimum of food security? How could the quality of their lives be improved? Their self-reliance was a remote dream, an ambitious ideal, but too hazy to be seen as a practical short-term objective.

The Road

Those dreams were repeatedly dreamt over years, especially when the rainfall was less than the 400 millimetre annual average. Crops failed; animals perished; people starved. Even the little arable soil was being swept away by erosion. In May 1969 the parish priest in Alitena, Abba Yohannes Welde Giorgis, later the Bishop of Meki, realized that the immediate future only held two alternatives: the migration of the people, but to where? since two petitions to the provincial government requesting land elsewhere had failed; or build a road to break through an inaccessible region and make it accessible. He shared his concerns for the people with Bro. Max Gmur, M.Afr., a Swiss, and together in May 1969 they decided that the road was the only practical alternative. Some international agencies were approached for aid in making their dream become a reality, but they baulked and dismissed their dream as nothing more than a pipe dream. Abune Hailemariam Khasay, Eparch of the Eparchy of Adigrat, however, encouraged them to try. Undaunted, Bro Max drew up the first tentative route and work began that year. Zelanbessa was their starting point and, 35 km to the east, Alitena was their objective.

By October 1971 the meagre, initial financial resources were running out. A number of men volunteered to work for nothing, but as that happened to be a year of irregular rainfall with a consequent shortage of food, the workmen faced an added difficulty. The civil authorities, moreover, faced the prospect of food hand-outs. After some discussion, however, it was agreed that while those who were unable to work would receive allocations of food and ablebodied workers would be given cash for their work on the road. In this way was initiated what became known far and wide as either cash-for-work or food-for-work. Accordingly, the authorities provided 26 tons of grain. But since an international radio programme had described the Ethiopian terrain as being one of the most difficult in the world, echoes of the audacious road project began to create curiosity. With the intention of seeing the work for themselves, Fr. Kevin Doheny, C.S.Sp., of the Catholic Secretariat in Addis Ababa,
The Way Ahead

Where do we go from here?

Once the road had been opened, it was possible to undertake improvements, protection against erosion, landslides and flash floods. To make it an all weather road a bridge was needed. During 1975 this was built by Joseph Carreiro, a Canadian engineer, in collaboration with Bro. Adelbert Tilman, M.Afr.

But the road was not an end in itself; it was a means to an end. The long-term objective involved land and water conservation, which would have the direct effect of improving the economic life of the people. In a rather casual manner the question of a dam had been mentioned the previous year, but Abba Johannes Woldegiorgis had given the matter serious consideration. In 1974 he asked Caritas Switzerland for assistance in studying the potentiality of the site on the main river. In response to his request Prof. Peter Widmoser of the Polytechnic Institute of Zürich, Switzerland, had studied the feasibility of a dam at that site in 1974. But as a priority Prof. Widmoser had recommended that the management of water should be improved by the implementation of a variety of soil and water conservation measures. That recommendation was followed up by the Eparchy of Adigrat with the establishment of ADDA in 1975.

Infrastructure Established

An undertaking of this magnitude and duration entailed other issues: considerable financial backing; the availability of a competent engineer, who would train local labour and supervise the technical work; and, also the administrative infrastructure together with an Irish engineer, Mr. P. Vahey, visited the site in 1973. In his report Fr. K. Doheny wrote: ‘The project is an ambitious one and the work is nothing short of heroic — cutting through hard rock with sledge-hammer and chisel. I watched them with admiration and astonishment. In places they have built up the side of the mountain with walls 25 feet (7 m) high to support the road. It is incredible work — a most ambitious undertaking, which is succeeding.’

Mr Vahey mentioned in his short report the possibility of harvesting water by constructing a dam on the main river. The plight of the people throughout the region in 1973 was further aggravated, as besides the lack of rain, pestilence in the cattle prevented the people from selling any of their cattle, sheep or goats. Once again the local authorities provided food-for-work. Admiration for the workers’ heroic attempts to cope with the steep and tortuous terrain had, meanwhile, spread. Caritas (Germany) generously responded later that year with the assurance that they would finance the completion of the road to Alitena.

The provincial authorities now became engaged and provided two graders, a bulldozer, a compressor and dynamite. Gigantic rocks, which had previously remained impervious to picks and chisels, were blasted away.

By the turn of the year, on 5th January 1974, two days before the Ethiopian celebration of Christmas, all was ready to open the road. Since the initiative had originally been taken by the Eparchy of Adigrat, the Eparch, Abune Sebhat-Leab Worku, was given the privilege of riding in the lead Landrover, followed by seven other Landrovers, one Renault, two graders and one bulldozer. About 200 people were dancing around the triumphal arch erected at the entrance to Alitena. Beyond the entrance, however, thousands of people had flocked from the surrounding mountains. For the small children this was their first time to set eyes on a motor car. The whole experience was reminiscent of Christ’s triumphal entry into Jerusalem. Alas, the people were too impoverished to provide food for a feast but that problem was solved by the Eparchy of Adigrat. During the feast that followed they were able to take their fill and, at least for one day, forget the lean times. It was not just a celebration of four and a half years arduous work, rather was it a celebration of revived hope. There were virtually no private cars in the region, but with a road the people had the prospects, however remote, of travelling by transport to the main road at Zelanbessa instead of walking for eight hours.

Image: Farmers private check dam at Masana Daga.
to be provided by the Diocese of Adigrat. In that capacity, what had been a diocesan Catholic Social Action Committee became the Adigrat Diocesan Catholic Secretariat (ADCS) which included a department, the Adigrat Diocesan Development Action (ADDA). The purpose of ADDA includes the conservation of soil and water, to facilitate food security in the eastern parts of the Tigray Regional State, and to raise the people’s quality of life.

The overall responsibility for ADCS and ADDA lies with the Bishop of the Eparchy (Diocese) of Adigrat. He appoints the Project Co-ordinator and the members of his staff, who, together, form the Project Support Structure. Close contact and consultation, however, is maintained with the local government authorities. Through their mediation the present Ethiopian Government exempted the importation of necessary materials from duties and custom charges. Technical supervision, in the name of the donor agencies, has been provided by Bruno Strebel both during his time of residence in Alitena and on his regular visits. In fact, he was the only expatriate directly involved in this massive undertaking.

Prof. P. Widmoser had considered all the problems related to soil and water conservation over a catchment area of approximately 450 square kilometers. Soil erosion had accelerated owing to deforestation and bad use of the land. Rainfall was irregular, and when it did rain there were short, intensive storms. Prof. Widmoser had made a series of practical suggestions: check dams, well digging, protective walls against erosion, irrigation, afforestation and water storage facilities. As a factor in finding a solution to these problems he raised the possibility of constructing a dam on the Barbare Gade River (quite frequently incorrectly called the Muna) at the gorge between Kinkintai and the high, steep cliffs of Assabol. The dam would not be intended to serve hydroelectric purposes, but to conserve water in the face of acute shortages, and facilitate irrigation. It was even suggested in his study that the dam would be 42 m high, and that would make it equal, at that time, to the highest in Ethiopia for similar purposes.

What had initially been the mere construction of a road was now being justified, not as an end in itself, but as means to ends of much greater significance for the whole region.

**Dr. Bruno Strebel**

Towards the end of 1974 the Communist regime executed 60 prisoners and that consolidated the regime’s stranglehold on Ethiopia in the following year. By contrast, Bruno Strebel’s arrival in Ethiopia in January 1975 represented a gleam of hope, at least for the people living in the vicinity of the Zelanbessa-Alitena road.

Bruno Strebel was born in Zürich, Switzerland, in February 1949. He grew up on the shores of Lake Zürich, then became a primary school teacher, and later studied hydrogeology and biology at the University of Zürich. As a sideline he worked at different construction jobs and acquired various practical skills. For several years he worked at the headquarters of Caritas Switzerland; then, for three years he was attached to Helvetas as a monitor of an environmental project in Nepal. In 1985 he...
launched his own consultancy firm and gained valuable experience while working in Europe, Eastern Africa, Central Asia and Southern Asia. Over those years he has specialized in environmental issues related to the use and the protection of water. He is married to Ursula and is the father of two daughters and one son. In his feasibility study of 1974 Prof. P. Widmoser had stressed the need for an engineer-supervisor with technical competence, the ability to train local labour, and physical endurance, as he would have to walk long distances over rugged, mountainous terrain. Bruno Strebel was to prove beyond all doubt that he had all those qualities. But before undertaking any particular technical challenges, however, he surveyed the whole region on foot. Only then, after having walked 10,000 km in the remote countryside, did practical steps begin to form in his mind. Furthermore, while trekking the mountains he had passed over 200 nights sleeping in local farmhouses. That proved to be a most valuable experience, as with mutual knowledge, so did mutual confidence grow.

From his experience of the terrain, he envisaged, at least to begin with, one of the simplest and least dangerous effective measures in combating soil erosion. The local people had already been building check dams to try and reclaim land. Bruno came to the conclusion that they could be improved and perfected. After several of these had been built and proved to be effective, he returned to Adigrat one day full of delight. He had photographs of small children at play. They were actually playing at building little check dams with stones. Bruno commented that as the children had now got the playful idea, when they grew up improved check dams would become a regular item in combating soil erosion.

The Communist regime unleashed a policy of Red Terror in response to mounting unrest. On the slightest pretext, or for no pretext at all, innocent people were gunned down in the streets. No one was safe. The whole aim of the policy was to subdue the people by striking terror into their hearts. In many ways it resembled the Reign of Terror at the time of the French Revolution. While such unbridled terror may have subdued large sections of the population, it proved to be counterproductive among many others. These fled to the mountains and organized themselves into units of armed guerrillas.

Bruno Strebel, although living and working in the mountainous terrain around Alitena, was never in any danger since he had already earned the trust and respect of the local population. His mere presence in that region, however, represented an unspoken challenge to the military might of the Communist regime; it was an embarrassment to Marxist hardliners. On the pretext, therefore, that they were concerned for his physical safety, the local authorities obliged Bruno to interrupt his work and return to Switzerland in the summer of 1976.

Over the relatively short period of his stay, however, and while surveying the area on foot, Bruno had gathered geographical data covering the whole region. But once he had been obliged to return to Switzerland all the collected data enabled him to produce in 1978 a geographical survey of the Bukniti area region and that included a contour map. It was only some time later, in 1985, that Bruno managed to return and resume the work that he had been forced to abandon.

**Who Can Work Without Food?**

*Hunger and Famine*

What might be entitled Phase II of the ADDA project coincided with the years of acute famine. In general terms those years of famine covered 1983 to 1989. In 1983 there were only 309 m of rain recorded in the area, and, even worse, in 1984 only 262 m. By the middle of October, just when the harvest should be completed, an estimated 400,000 people were starving in the administrative region where ADDA was working. According to some reports at that time in Ethiopia 10,000,000 were starving and more than 1,000,000 were already dead. An English newspaper, The Guardian, dated 24th September 1987 said that a million people in East Tigray alone no longer had the means to live. At the end of October 1987 the B.B.C. reported that 75% of the harvest in Tigray had been lost owing to the lack of rain.

When consideration is given to the fact that in an ordinary average year the annual income per household was $110, and that infant mortality was 16.8%, the challenge to simply exist can only be imagined, never mind development and any steps towards self-reliance. In responding to the needs of the people during those years of famine the road proved its justification both in terms of hard work and money spent on its construction. The policy previously introduced of food-for-work was, beyond all doubt, beneficial to the people. Although work was scaled down because of physical weakness, nevertheless, the construction of check dams and water catchment areas continued.
At a later date, when the civil authorities were assessing the famine, they recognized that the actions of the Catholic Church had saved approximately 200,000 lives. Those who had made contributions to ADDA, together with those who implemented the projects, have every right to rejoice that they had contributed to saving so many lives during a time of abject famine.

**A Variety of Developments**

If any further justification of the ADDA project was called for, the famine had provided ample proof. Gone was any lingering local scepticism, only to be replaced by contagious enthusiasm. The farmers had become aware that by putting into practice Bruno’s manual on *Soil and Water Conservation* the quality of their lives and those of their children could be improved. Their fatalistic attitude, bred from being continually at the whim of climatic conditions, was being changed.

By 1991, so almost two decades after the opening of the road, a network of 110 km of footpaths and mule tracks had been traced through the roughest, mountainous terrain. Over that same period, under the inspiration and direction of Bruno Strebel, the water and soil conservation project had accomplished 32 hand dug wells, some as deep as 25 m; 381 check dams had been constructed, varying from 3 to 15 m in height; 4.5 hectares of hillside terracing had been implemented; 10 hectares of fruit and vegetable gardens had been planted and protected by 4,700 m of wall along the side of the river. All in all, throughout the catchment area approximately 60,000 people of different religious denominations were beginning to benefit from the variety of developmental initiatives.

**AND WHAT NOW?**

Once the Communist regime, the Derg, had been overthrown in 1991, work on the various aspects of the ADDA project was resumed in earnest. Soil conservation was the immediate priority involving terracing, nurseries for seedlings and afforestation. But the thought of a dam, as the ultimate hydrological solution to provide a regular source of water for household purposes and irrigation, always hovered in the background.

In ordinary circumstances ADDA’s policy is to support small scale land development activities, but the prospects of building a dam at Assabol was accepted, in principle, as an exception, because of the unique potential of the site and the realistic possibility of boosting agricultural production by means of perennial irrigation.

Before going any further, the proposal of a dam was discussed with Mgr. Kidane-Mariam Teklehaimanot, the Eparch of the Adigrat Eparchy, and Abba Hagos Weldu, the local parish priest and project co-ordinator. The Bishop made it clear that the church was willing to endorse and support such an undertaking on condition that the design and construction should be of the highest quality so as to rule out any possibility of technical failure or mishap.

**Initial Apprehensions**

To speak of local opposition to the dam at Assabol would be an exaggeration. Perhaps it would be more appropriate to refer to the initial local reaction in the terms of psychologists when they speak of the ‘inhibition of the unfamiliar.’ Apart from the check dams that improved the cultivation of terracing down the slopes, local farmers had never seen a dam, neither could they imagine how such a high dam could be built. It was, therefore, virtually impossible for them to weigh in a balance risks and benefits.
Their apprehensions stemmed, basically, from the fear that the dam might break and sweep them to destruction; they were also concerned about the negative effects it might have on their fields and grazing grounds. Farmers are pragmatists and it is difficult for them to evaluate the relationship between the common good and individual benefits. Explanations, moreover, referring to the long-term ecological benefits that the dam would provide were too abstract and remote for them to imagine.

Dr. Bruno Strebel and his collaborators worked patiently to alleviate the apprehensions and concerns of the farmers, especially in the vicinity of the dam. Slowly but surely they eventually got the farmers support, although at first it was hesitantly given. Over the years there has never been any attempt to undermine or sabotage the ongoing work, and that, in itself, bears testimony to their success and the good sense of the local community. "Wait and see!" might be appropriate words to express the initial local reaction.

Progressively, such reservations, for the most part, have given way to positive, even enthusiastic support. A major step was taken in this regard when Dr. Bruno wisely discussed the matter with the appropriate civil authorities. They visited the construction site and have frequently sent their experts to inspect the progress of the work. Their approval and endorsement of the dam went a long way in dispelling any lingering apprehensions.

In response to the Bishop's comments it was decided to hire a consultancy firm to conduct a feasibility study by specialised and experienced dam engineers. Such a study was estimated to cost about CHF 50'000 and to be completed by 1995. There was an added bonus to such a study: it would speed up negotiations involving decisions by government officials.

Later that same year, 1995, Andrea Pozzi and Bruno Strebel drew up the original feasibility design of an archetype dam to be constructed with cement masonry at Assabol (today's site of the dam). Such a mighty undertaking, to ensure efficiency, safety and taking into account economic considerations, called for further consultation. Accordingly, in January 1996 Urs Schaffner and Raini Schrämli, Swiss engineers, were requested to carry out further studies and to advise on the dam's initial practical implementation. They recommended that given the nature of the quartz-porphyry rock and archetype construction in concrete would be better suited than cement masonry. They also suggested that the dam should be constructed 30 m further inside the gorge of Assabol. This new site provided easier access to the best rock for the foundations, the availability of stones and a safer place for the use of the necessary explosives. The width of the dam, however, would have to be modified from 8 m to 15 m. After due consideration and reflection their recommendations were accepted.

All the revised calculations were made by Niederer and Pozzi engineers, Uznach, and CES Civil Engineers, Aarau, Switzerland. In June 1996 their report on the Static Calculation was submitted for approval to the Sustainable, Agricultural, Environmental, Rehabilitation of Tigray Commission (SEART). With SEART's approval, in principle, the whole endeavour had now received the all clear to go ahead.

These protracted consultations may have been time-consuming, but they illustrate the serious measures taken to avoid risks and leave nothing to chance. Safety and efficiency were more important than speed. Even when the blasting of rocks was necessary, the undertaking was supervised by Raini Schrämli (Swiss mountain engineer and blasting expert), Urs Schaffner (civil engineer) and Bruno Strebel (geographer). All the records of these engineers' visits have been carefully preserved.

Nature, however, can be unpredictable and disrupt the most meticulously calculated plans. Just when 300 cubic metres of sedimentation had been dug out to begin work on the foundations, a massive flash flood cascaded down from the distant mountains at the beginning of March 1996. Another 300 cubic metres of sedimentation was then deposited, replacing what had previously been dug out. That, too, had to be dug out before reaching the bedrock, 1.5 to 2.2 metres beneath the sediment. Another frustration had delayed the laying of the dam's foundations.

Logistical Considerations

Now that the go-ahead for the construction of the dam had been given by the local authorities, the latter half of 1996 was taken up with the practical implementation of the basic infrastructure. Visitors to the site can judge for themselves the efficiency of the dam in fulfilling its purpose. What they do not see, however, is the painstaking logistics underlying that efficiency. Studies of the rock's solidity had to be carried out; possible natural hazards, earthquakes and landslides further up the valley, had to be taken into consideration and evaluated; explosives had to be precisely calculated; a gallery 60 m long and 2 m wide had to be blasted and excavated to allow access to the actual site of the dam in the gorge. Equipment and materials were needed, some might be available in Ethiopia, while others would have to be imported. Before reaching any concrete decisions, these matters had to be investigated. Without going into all the details, mention can be made of the search for about 2,500 cubic metres of good quality aggregate; a compressor for crushing stones was required, as well as a concrete mixer, and all those items had to be bought; 300 m of rail, 200 kg of explosives, 100 m of safety fuse, 500 m of detonating cord, were all essential items to the actual construction.

Would it have been better to have employed a contractor to execute the undertaking? After considerable discussion that suggestion was rejected for many reasons. Any contractor accepting a contract for such an undertaking in a remote, mountainous region would have raised the costs astronomically. Instead, it was decided to implement the scheme by using local labour and subject to regular supervision by Bruno Strebel. Andreas Ghebray, a trained and highly skilled technician, who had the advantage of being from the district, was appointed the responsible technician in charge of the site. He spent the summer months of 1996 looking for and thoroughly examining the required equipment that might be locally available.

Interestingly enough, at that particular time changes in the attitudes of both local people and government representatives, who had visited the site, were observed.
Growing optimism began to replace initial scepticism; a sense of self-confidence and pride was being instilled in the people. They had good reasons for that as one of the highest hydraulic dams in the whole of Ethiopia was being built in their locality, and to which they were contributing, especially by the employment of their own manpower.

By September 1996 all the preliminary tasks had been accomplished, and, in addition, a store near the gorge had been built, while a bigger one nearby was nearing completion. But there were further delays owing to the late arrival of equipment that had to be imported from Europe. Other complications arose owing to the difficulty of finding the appropriate explosives. It was, therefore, foreseen that the actual construction work might begin in January 1997.

By 29th January 1997 all was now ready to begin laying the concrete foundations of the dam (13 m x 8 m x 3.5 m). Representatives of the local government participated in the official ceremony to mark this auspicious occasion. Prior to that occasion there had been a number of delays, but that does not mean that time was wasted. It provided a useful occasion to assist the farmers, both in this particular locality and elsewhere, to become engaged in activities other than just farming. Some of these might be mentioned: improving beehives, stone quarrying, the construction and operation of small local mills, and the processing of agricultural products. These activities helped farmers to achieve some financial independence by stimulating the local economy.

Taken by Surprise!

But just when the blasting works and the excavations of the rocks, prior to laying the foundations, had been completed and hopes were running high, disaster unexpectedly struck in May 1998. Hostile Eritrean armed forces moved in and occupied the whole area. Bruno Strebel was forced to quickly abandon the site; further progress was brought to a halt, and no one knew what the future held in store. Within just over two years, however, the Ethiopian armed forces had totally repulsed the invaders. In the areas, however, that had been deeply affected by the invasion there was a shortage of food. The government, therefore, supplied basic emergency rations to the people, 15 kg of wheat and 120 gr of edible oil, per head, per month.

Work at Assabol could begin once again, after an interruption of close on three years. Bruno resumed where he had been obliged to leave off, but reactivating the various activities of the project took time. Trained staff had been dispersed as they looked for work elsewhere, and it took a little time for them to return to their former employment. Furthermore, during the war unprotected equipment had either aged or been damaged from exposure to the weather.

Frustrations of all kinds were dogging the implementation of ADDA’s ›magnum opus‹. But the remarkable tenacity and determination of Bruno Strebel served as a pole enabling him to vault over all the obstacles. That tenacity was inspired by a further consideration: conscientious fidelity to all those kind and generous people, individuals and agencies, who

Image: Different views of the pipeline from Assabol to Alitena (riverbed, before/after Kitra and Musea tunnel).
continued to provide financial support for this ambitious undertaking. They had every right to see that, despite unexpected delays, their generosity was bearing fruit. Just after the Eritrean army had been driven out, and before any of the international agencies had focused their attention on the plight of the people, Barbara Strebel, Bruno’s niece, came and worked for two years. She was instrumental in establishing the Women’s Promotion Centre (WPC). Gender equality now began to be promoted at community level, as women’s technical, financial and managerial skills became the priorities of the WPC. Barbara also assisted them to co-ordinate income generating activities and how to use available water for household purposes, sanitation and hygiene. Gratitude must be expressed to the Swiss government for having made available a special fund to support those activities.

The effective implementation of such initiatives had become possible because peace along the border had enabled ADDA to reactivate the pre-existing infrastructure network. Owing to the war the road had been neglected, now it was restored and improved. Over 100 houses that had either been damaged or destroyed were reconstructed. As a result of terracing, covering many square kilometres, degraded grazing ground was rehabilitated. In due course, this will improve the quality of livestock and is foreseen as going hand in hand with improved veterinary services. With clean water becoming available, the strenuous task of women having to carry water over long distances to their households was being reduced.

When taken as a whole all these various ecological undertakings share the common goal of promoting the people’s quality of life and providing them with food security by agricultural development and income diversification. Previously, in the vicinity of the dam market gardening was neglected. Without a reliable, steady irrigational system the cultivation of fruit and vegetable gardening would have been futile. All that, however, is now changing as about 800 families will each be freely given 500 square meters of land for gardening. From the sale of their produce the families will be able to improve their economic situations.

At the beginning, as has previously been mentioned, Abba Yohannes Weldegiorgis had tried to resettle the people in view of improving their quality of life. His failure led to the building of the road. With time, the road enabled major developmental projects to be launched. Now that the economic conditions of the people were improving, the pressure for resettlement was diminishing.
2. Assabol Dam, Cross Section, B. Strebel, 2008, as executed.
5. Assabol Dam, R. Schramli, February 1996.
8. Layout Section at Dam Foot, Niederrer + Pozzi, June 1996.
13. Cross and Layout Section at Dam Site, Niederrer + Pozzi, 1996.
**Panorama Map**

of Irob Woreda and Surroundings

Looking from the Red Sea towards West,

facing the Eastern Escarpment of Northern Tigray

30 km / 2000 m altitude drop

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**Different Schematic Sketches from Bruno Strebel about**

Lay-Out Pipe Network for the Irrigation System at Assabol.

Technical Fact Sheet

Concrete foundation on solid rock: 13 x 8 x 1.5 meters
Height of arch dam: 42 meters
Width of arch dam: 10 – 12 meters
Thickness of arch dam: 8 to 4 meters on top
Volume of concrete: 2'600 cubic meters
Volume of cement masonry: 1'150 cubic meters
Drystone masonry constructed: 1'700 cubic meters
Volume of rock blasted: 650 cubic meters
Sluice gate with 24 m3/sec capacity at level 22.50 m above foundation
Storage capacity of reservoir: 1'000'000 cubic meters
Surface of reservoir area: 6.5 hectares
Length of lake: 1'700 meters

Compilation of Total Construction Costs

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<td>966'000</td>
</tr>
<tr>
<td>Imported Goods</td>
<td>320'000</td>
<td>2'240'000</td>
</tr>
<tr>
<td>Total Dam Construction</td>
<td>1'573'000</td>
<td>11'011'000</td>
</tr>
<tr>
<td>Distribution System</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Local Staff and Labour</td>
<td>280'000</td>
<td>1'960'000</td>
</tr>
<tr>
<td>Local Materials, Pipes and Fittings</td>
<td>59'000</td>
<td>413'000</td>
</tr>
<tr>
<td>Transport and Fuel</td>
<td>15'000</td>
<td>105'000</td>
</tr>
<tr>
<td>Cement</td>
<td>56'000</td>
<td>392'000</td>
</tr>
<tr>
<td>Technical Consulting</td>
<td>42'000</td>
<td>294'000</td>
</tr>
<tr>
<td>Imported Pipes and Fittings</td>
<td>144'000</td>
<td>1'008'000</td>
</tr>
<tr>
<td>Total Water Distribution System</td>
<td>596'000</td>
<td>4'172'000</td>
</tr>
<tr>
<td>Grand Total, entire Assabol Scheme</td>
<td>2'169'000</td>
<td>15'183'000</td>
</tr>
</tbody>
</table>

Assabol Flood Water Harvesting Scheme

1 Technical Fact Sheet, B. Strebel, May 2008.
2 Compilation of Total Construction Costs, B. Strebel, May 2008.
Rainfall during Kremt: 300 mm
During year: 650 mm
Run-off: 15%
All diagrams are part of the master thesis of Andres Strebel: Sedimentation Processes in the Assabol Watershed in North Ethiopia, University of Berne, 2007.

1. Location of the watershed in the rain shadow
2. Discharge amounts of flood events
3. Suspended load measurements during a flood
4. Bird view of the reservoir
5. Three dimensional model of the reservoir
6. Drainage measurements of four sediment samples
7. Cross profile in the lower part of the reservoir with sediment banks and incised channel
Reaching for the Sky

The beginning of the dam.

To blast away some 300 cubic metres of rock was a daunting, technical challenge for the workmen, especially as it entailed hanging vertically by ropes down the face of the cliff and using jackhammers. That whole operation took from November 2000 to September 2001. Tragedy struck at that stage, as one worker, Welde, became entangled in cables, tripped and plunged to his death.

Urs Schaffner visited the site in January 2001. He made sure that the alignment of the dam in the specified wedged-shape position was precise, and then supervised the laying of the foundation stones.

Slowly but surely the hundred or so workforce began raising the height of the dam at a monthly average of one metre. As the dam rose above the level of the gorge the danger of damage from occasional flash floods diminished. Transporting heavy materials, however, from the end of the access road to the actual dam was slow and backbreaking work. To lighten and speed up the work the installation of a Wyssen cable crane with a capacity of 800kg began in November 2001. By January 2002 the initial trial runs of the crane had been successfully carried out. The benefits of the crane were immediately obvious. Now, besides speeding up and reducing the heavy manual work, constant supervision of the dam’s exact position, down to the last centimetre, was possible.

Just when the dam had risen to a height of above 5 metres, on 21st March 2002, a flash flood swept down from the mountains. No harm was done, as the dam withstood the shock of the cascading water, but work was interrupted owing to the volume of sediment and flowing water.
**Small Scale Irrigation and Road Works**

The interruption of construction work was not a waste of time, as it provided the opportunity to undertake related logistical matters and irrigation. A generator and telephone were installed, the access road had to be maintained, a shed built to house the winches of the cable crane and a welding machine purchased. Along with the steady development of water resources small scale irrigations began to spread. But they had to be inspected and supervised. At Dawhan, for example, it was hoped that by April 2003 a supply of water would begin irrigating pilot garden plots. At other sites, including Kelez, water was being supplied by innovative infiltration galleries at 1 litre per second, and the results were encouraging; at Wuzzaff the original 37 check-dams were proving to be a good example of water conservation and appropriate irrigation; and at Alahcollo a 2.5 m weir has been constructed in cement masonry. The pond behind the weir serves the local people in a variety of ways, not least, an attractive, safe swimming pool.

The possibilities of extending the irrigation network were examined. Around Kalla Assa and Assmuth, since the terrain is at a higher level, water could only be supplied by pumps and pipelines. That became possible thanks to ELPA for having provided a supply of electricity by cables.

The Gunda-Gunde road was supervised at that time. In the short distance of 2 to 3 km there was a very steep descent of 150 m. In order not to transgress the rule that a gradient should never be more than 10%, two hairpin bends had to be cut through rock. On inspection the bends were too narrow. To allow cars to pass without having to manoeuvre the bends were then widened by blasting away some rocks.

On several occasions, when for good reasons the construction work at the dam of Assabol has been interrupted, time was taken to give the workforce systematic training. Mere brute force was quite insufficient, when so much of the work relied on the use of sophisticated machinery and technology. A lot of that training involved ongoing instructions. Particular attention was paid, however, to the Operation and Maintenance (OM) staff. Detailed rules had been drawn up for the OM staff and they covered such items as:

**Operation:** During flood times flushers must be open as well as the dam site valve; the main pipeline must be flushed once a week at every flusher. Outside flood times the main pipelines must be flushed once a month. **Controlling:** The condition and functioning of the tap stands. Cover and condition of pipes and channels. Instructing children not to play with the installations. **Data collection:** Use of water. Water level of lake. Date of floods, their impacts, rise of water level and colour of water. **Record keeping:** Each participant has been given a notebook where he must note down on a daily basis all his observations.

Another form of training, although less technical, nevertheless, useful for the local communities and/or school children involved an introduction to the Solar Water Disinfection (SODIS) procedures. That training involved local promoters who would understand the need for SODIS and its practical implementations at household levels.

As the dam began to rise slowly, the threat of flash floods, which previously had occurred as often as ten to twenty times a year, began to decrease. The land below the dam could now be cultivated and made into gardens without any fear that the plants might be suddenly swept away. All kinds of vegetables, many for the first time, began growing in abundance. Besides vegetables like potatoes, tomatoes, cabbages, onions, spices and fruit trees were also planted. Within a short time such crops would have a beneficial effect on the diet of the local people. By selling their surplus produce, moreover, their economic situation would also improve.

To maximise the benefits of the developing horticulture, Helvetas were invited to share their expertise by training the women and the farmers. One of the outstanding results of co-operating with Helvetas concerned the use of prickly pears. Cactus plants grow wild and cover large areas of rocky slopes. For about five months of the year they yield an abundance of figs, called ‘prickly pears’. These are usually plucked when ripe and eaten raw, but thanks to the expertise of Helvetas no less than seventeen different tasty dishes were produced. Even the marketing name of Green Gold was chosen.

At the outset, in view of encouraging horticulture, 800 m of pipelines were laid and, where feasible, irrigation channels were built. Within a year, however, over 2 km of pipelines had been laid. Although the dam was still far from finished, the people roundabout, nevertheless, were already beginning to benefit from the controlled, regular supply of water to their gardens. Not too far from the dam a demonstration garden and tree nursery were planted. It was agreed that the demonstration plots will focus on greater diversity and include as many crops as possible, fodder crops, multi-purpose trees, perennial crops and short term maturing vegetables. Some crops will be experimental, and will be labelled as such. Only small numbers of such crops will be planted and of any particular species there will be no more than ten plants. These areas will be protected from any invasion of monkeys by long strips of wire mesh and electric fencing.
The Growing of the Dam

By the end of August 2004 the dam had reached a height of 17.5 m. Behind the dam a lake had formed to the delight of the people, who had never seen so much water before. For the purpose of working on sections of the dam at the side of the lake a boat (8 m x 2 m) was built. While the controlled supply of water was beneficial for horticulture, there was also a downside, which had to be taken into calculation. In an average year the amount of water that rushed down from the mountains could reach 20 million cubic metres and as much as 500'000 cubic metres of sediment could be deposited against the dam. The sand and the gravel could prove useful as an artificial ground water reserve. The fine silt, however, had to be disposed of so as to avoid silting up. Prof. Andreas Huber and Karl Wehrle of the Swiss Centre of Appropriate Technology (SKAT) proposed a sluicegate as the solution, but it would have to be imported since it was not available in Ethiopia.

By the end of May 2005 the dam had risen to a height of 21.5 m and the artificial lake behind it was now calculated to hold 15'000 cubic metres of water. The retention of the lake had permitted a constant flow of water downstream, to the amazement of the people. It might be said that Assabol had now become functional. Since Urs Schaffner had previously given training in hydraulics to several of the local technicians and skilled workers, the flow of water was controlled, free from danger, and absolutely safe. The facts were checked and verified by two experts from the Tigray Bureau of Water Resources.

Related Developments

While concentrating on the building of the dam at Assabol, other developments at quite some distances away should not be overlooked. At several places the benefits of check dams were plain for all to see. Even in those districts where there had been little or no rainfall, sequences of check dams had produced fruitful results in preserving the ecology of the landscape. Despite the lack of rain for seven months valleys that had many check dams remained green because the conserved water continued to flow.

In one remote, precipitous region, Ara’e, about 7 to 8000 people actually live, although there is a constant increase in population thanks to the pastures and the abundance of honey. Of all the places on earth, Ara’e is considered to be one of the most geographically hostile. It is remote, prone to drought and surrounded by a hostile desert of rocky mountains. For centuries people have lived on top of mountains and hills and for drinking water they were obliged to walk down to the low valleys. Between walking and carrying people were often driven to the limits of their physical strength. Donkeys become so exhausted that they are unable to reproduce and new animals have to be brought in from elsewhere. The poverty of the people and their physical stress is simply shocking.

Bruno had an experience while exploring the region which illustrated the hardships entailed in trying to get water. He met a woman carrying a jerry can of water. To avoid
the heat she left her house in the middle of the night and by dawn she had reached the riverbed. After filling her Jerry can she then had to walk for five hours to return home.

The Eparchy of Adigrat has recently opened a parish in Ara’e and ADDA has become operational through the parish. In an effort to alleviate the physical hardship of the people it has sponsored the digging of wells, many by hand, and water conservation schemes have been implemented. Some check dams and eight cisterns have been built to create a perennial source of water. Another five cisterns are foreseen as part of future planning. It might be said that ADDA has been responsible for having introduced some form of modern development into that hostile region by constructing, for example, an impressive network of footpaths over those mountains. Prior to that any European would have been obliged to make use of his hands and climbing techniques to move about.

Mention has already been made of the production of tasty dishes from the prickly pears of the cactus. Ten women are now employed in making twelve different dishes. Jars of Green Gold have been sold to restaurants and hotels in Adigrat. Since the last harvest of the prickly pears all have now been sold and this undertaking has been a successful business promotion of the women’s co-operative. Further possibilities of expanding production look promising.

To help the people to take advantage of their horticultural productivity an Ethiopian agronomist will come in the near future and train them in market gardening. Before that takes place, however, certain legal issues related to management and ownership will have to be clarified. About twenty families were displaced by the expansion of the new administrative centre at Dawhan, but they received 500 square meters of land per family as compensation. In this context, however, it is worth noting that the construction of the dam at the gorge of Assabol did not involve the displacement of any families.

About 20 km east of Atitena there are approximately 500 hectares of flat, fertile land as Sengade. At present this land is only used for seasonal grazing. A steady supply of water for 6 months of the year, however, would be sufficient to produce fodder and an abundance of milk for the economic requirements of 500 families. Such an attractive proposition would induce a new route of migration towards the east. The seasonal supply of water could be provided by regulating the water level at the Assabol dam during the rainy season and by feeding a small dam reservoir (storage 10,000 cubic meters) near Sengade. Over the last 4 km into the heart of Sengade water could be supplied by a low cost gravity pipeline.

From these few, selected observations it can be appreciated that the construction of the dam at Assabol does not just represent a remarkable, isolated achievement. Rather does the dam resemble a heart pumping water, the lifeblood, essential to humanity, cattle and horticulture. In due course, by-products arising from the availability of water will have a profound effect and play a significant role in contributing to raising the local people’s quality of life.

**Progress at Assabol**

By the end of October 2005 pipelines had been laid leading from the dam. The main pipeline inside the gorge was 85 m long, another 50 m was added to reach the demonstration site, and still another 200 m to join up with the channel leading into Dawhan. In the interests of economizing tunnels were cut through rock to carry pipes. With three men working at a site it was estimated that they could chisel through 30 cm per week. The work might be slow, but economically speaking it was advantageous. Once the pipes had been laid, it was now possible to start irrigation as the reservoir behind the dam still contained 40,000 cubic metres of water.

During the spring of 2006 an extremely massive flash flood rushed down from the Eritrea watershed. Such a torrent of rushing water provided an excellent test of the dam’s durability. Thankfully, the dam withstood all the pressure.

The sluicegate arrived in June 2006. Although the dam now stood at 33 m it had been foreseen that the sluicegate would be inserted at a height of 22.50 m. As an extra safety devise an additional drainage pipe was inserted at 32 m just in case the sluicegate might get blocked at some stage. Owing the volume of water, ten times more than in the previous years, the complete installation of the sluicegate was postponed until after the rainy season in October. There was also another problem that delayed the work on the dam as for several weeks cement was simply not available.

Finally, in October 2006, when the dam had risen to a height of 36 m the sluicegate was installed. Operating the sluicegate is a delicate matter so as to maintain the
From the very beginning it had been foreseen that problems might arise in the future owing to the build up of massive sedimentation. In years to come, it might even be repeated. But the experience of similar problems in other countries, Algeria and China, for example, leads us to believe that by the proper operation of the sluicegate and a full lowering of the lake's level for about one month a year it is possible to flush out accumulated sediment. The shape of the reservoir is rather like a canyon, which, together with the massive run off of water, are favourable factors in flushing out the sediment and establishing a long-term equilibrium between clear water and sedimentation. It is now calculated that on a regular basis the lake will retain a volume of 500,000 cubic metres of water. Over a complete year that is quite enough to provide sufficient irrigation without looking for any recharge. Consequently, even if there should be drought, the water supply will be secure.

The temporary difficulties had been most unfortunate, but in trying to cope with the problems and finding solutions valuable experience had been learned in handling problems of silt and flushing out sediment. Even the sediment, however, can be used as fertilizer for the horticultural gardens. Despite those problems it was encouraging to note that none of the perennial crops in the gardens suffered any damage as the pumps had continued to provide sufficient water for irrigation.

Problems with the Sluicegate

By mid-2007 the dam at Assabol had reached its full height of 42 m, one of the highest hydrological dams in Ethiopia. To manage the operating of the sluicegate a winch inside a protective tower was installed. Eight members of the Operational and Maintenance (OM) team were given special training. The rainy season began particularly early and was very heavy in mid-2007. There was a run-off of 20 to 30 million cubic metres of water, twenty times more than the volume of the Assabol reservoir. Sediment deposits rose more than 30 cm per day and by the end of the rainy season the sediment level in front of the dam was 8 metres above the foot of the sluicegate. Overall, it was estimated that the volume of sediment deposited in the whole reservoir must have been between 300,000 to 400,000 cubic metres. Unexpectedly, for reasons which were not clear at that time, the sluicegate became jammed. Even the recently installed winch with a pulling power of 20 tons failed to move the gate. Owing to the height of the water flowing over the dam an alternative access was impossible. It was then calculated that the lowering of the water level by the use of the emergency drainage pipes and natural drainage would mean that access to the dam and sluicegate would not be possible before March 2008. So it came about, as predicted, that in March it was finally possible to install the shaft that drives the sluicegate and also the pipes inside the empty reservoir.
Flood Water Harvesting at Assabol

When assessing the future beneficial prospects of the dam at Assabol, it must be borne in mind that there is no consistent minimum flow of water in the rivers flowing into the lake behind the dam. Owing to the meteorology of the region and its geographical terrain massive flash floods from other areas of the vast watershed can sweep down in a matter of hours. Such a flood can contain 500,000 cubic metres of water, silt, grit and mud. This may happen even when locally there is severe drought. Once the flood has passed only a dry, stoney riverbed remains. Lives are not usually lost in these cascades, as local farmers shout warnings from the tops of mountains, but that does not stop its destructive impact.

The lake behind the dam has a length of 2 km and a surface area of 7 hectares. Together, both the lake and the dam, cushion the impact of flash floods, while retaining a regular supply of water beneficial to irrigation and other purposes. As an initial step, the water will be distributed by 12 km of pipelines and 1.2 km of irrigation channels. These should be completed by 2009. Should the local communities so decide, the distribution of water could even be further extended.

In any case, Assabol symbolizes the first ecological green belt in the whole region. Hopefully, it will inspire and encourage the cultivation of other green belts, even if they are on a smaller scale. For its part the dam stands as a monument to a pilot scheme of water harvesting from flash floods. Without the dam the raging water would simply cascade down the steep slopes to end up in the Danakil Desert and unproductively dry up at -120 m below sea level in a place with the hottest average yearly temperature recorded on earth.

Of all things, although intangible, the first fruit of this massive undertaking, so generously financed by benefactors, is to give the people hope. Other initiatives are born from hope, which, in turn, generates psychological equilibrium. Hope already animates farmers. In anticipation of obtaining a regular supply of water they are building terraces and reclaiming land that had previously been barren, rocky soil. Beneficial psychological effects can be seen as families now gather together in the evening, relaxing amid the plants and flowers of their gardens, which now resemble local oases.

Water can be compared to lifeblood, which we take for granted. From a regular supply of water so many life-supporting necessities develop, sanitation, hygiene, market gardens, fodder for cattle, and, perhaps, even fish farms. All of these advantages enhance economic security and improve the quality of life.

Even after the dam is fully operational, ADDA’s activities will continue to branch outwards. Just how long that takes, is not a matter of deep concern. Further developmental activities largely depend on the local population’s desire to undertake them. To a large extent, in turn, such activities are influenced by the cultivation of good relations between themselves and the local authorities.
Benefits to the Beneficiares

The benefits that will be provided by the dam at Assabol can be looked at from either the short-term or long-term perspectives. In the immediate short-term the formation of the artificial lake was seen as an advantage. Families had not been displaced and, now, water was easily available for domestic purposes. Recreational pursuits were also facilitated.

For centuries climatic irregularities and unpredictable flash floods had periodically wrought havoc to their agricultural endeavours. Even in a normal year the average rainfall would be below 700 mm and that would be confined to a specific period of a couple of months. Consequently, the cultivation of the fields was limited to approximately 10 weeks a year.

The dam at Assabol will neutralize the harmful effects of flash floods. Furthermore, from the water stored in the lake controlled irrigation means that the cultivation of fields will be possible for up to ten or eleven months a year even if the short rainy season proves to be inadequate. Such horticultural benefits will spread beyond the vicinity of the dam thanks to the pipeline and, where necessary, the pumps.

Although Ethiopia is approximately twenty-seven times bigger than Switzerland, Assabol is the first hydrological dam in the whole country. At a height of 42 m, without taking into consideration the 8 m of foundations, it is also the tallest in Ethiopia. Just now it is too soon, but in the future the dam will serve as an inspiration of what can be done.

At one early stage there had been a discussion as to whether or not a contractor might be engaged for the dam's construction. For a variety of reasons this suggestion was rejected. A contractor, quite possibly, may have finished the work in quicker time, but with the additional transport and haulage charges money would not have been saved. Neither would a contractor have taken time to train local expertise, as was done by Dr. Bruno and his associates. In the long-term the training they have acquired could prove to be highly beneficial both to the individuals and also to any future similar ecological undertakings. It should also be stated that with the employment of a contractor all safety precautions would have been outside the control of ADDA (Adigrat Diocesan Development Action).

Now the local workers can feel justly proud of their remarkable achievement. Their children and future generations can point to the dam and say 'our fathers built that under the technical supervision of Dr. Bruno.' Of course, it is to be understood that an individual did not stand alone, but was backed up by Caritas Switzerland and their associated agencies and countless benefactors. To them all, the Assabol dam is a monumental tribute.

Until now, owing to the unpredictable climatic irregularities, the people had lived a hand to mouth existence. All too often, when times were bad, they were obliged to depend on relief aid from outside to save them from drought and hunger. With the help of the dam they can look forward to ever increasing self-reliance. Just how many might stand to benefit is a matter of some conjecture but a range from 40'000 to 60'000 would be a reasonable estimate. The quality of their lives has the possibility of being improved by food security and additional related economic advantages. Finally, it might be added that the raising of the standard of living in the countryside is the best way to curtail the drift of young people to towns and cities.
Acknowledgements

The whole purpose of this brochure is to express appreciation and gratitude to the generosity of many agencies and, also, to the countless number of private donors without whose aid, big or small, this whole massive undertaking would have remained nothing more than a pipe dream.

To mention by name all the individuals, who either directly or indirectly, gave donations would be quite impossible. To risk doing so, however, would be unfair to those whose names, inadvertently, were omitted.

Through the whole process of administration it is much easier to mention the agencies by name: Caritas Switzerland (assisted by the Swiss Development Cooperation), Caritas Luxembourg (assisted by the Government of Luxembourg), Misereor, Arthur Waser Foundation and Ferster Foundation, and the Ethiopian Catholic Secretariat in Addis Ababa.

Appreciation and gratitude should also be extended to the Bishops of the Eparchy (Diocese) of Adigrat, the priests, laity and staff of the Adigrat Catholic Secretariat, and also to the local people of the catchment area. On occasion, when times were difficult, many of them gave their work freely because they were inspired by the vision of the benefits that would ensue to their families and neighbours.

Many individuals, at one time or another, have visited the site and contributed their expertise to the ongoing realization of this project. But in a very special way Bruno Strebel deserves particular mention. For over 30 years he has been the technical supervisor and animator of the whole undertaking. Undeterred by any inconvenience or temporary setbacks, this remarkable achievement now stands as a historical monument to the fruit of Bruno’s persistent dedication. During those years he has been fully supported by his wife and family, who deserve unstinting appreciation.

Authors

Kevin O’Mahoney, M. Afr.

Fr Kevin O’Mahoney, M.Afr. is an Irish priest of the Missionaries of Africa who came to Adigrat, Ethiopia, in September 1967. He was a member of the staff responsible for the education and formation of the seminarians at the major seminary. He wrote and published the history of the diocese as well as a historical novel of the Ethiopian revolution. After six years at the Irish Province Office, he was reappointed to Adigrat by his congregation in 2000.

Paula Troxler

Paula Troxler was born in 1981. In 2000, she began with her studies in visual communication, specification illustration at the Artschool HGK in Lucerne. She made her final degree in July 2006 and is working as an illustrator and graphic designer in her own studio. Paula Troxler spent three and a second time two months in 2007 in Ethiopia to do drawings for this publication. She had done about 400 drawings — a special selection of them is part of this book.

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The photographs on page 2 to 6 and 67 to 71 are all made by Bruno Strebel between 1996-2008 while his staying at Assaboll and the region. Some pictures on page 2 are made by Urs Schaffner, some portraits on page 69 to 71 are made by Paula Troxler, and the portrait of B. Strebel on page 3 is from Pia Zanetti. The comments on page 2 to 6 and 67 to 71 about the happenings and work processes are all made by Bruno Strebel in May 2008.

The schemes and plans on page 31 to 42 are made by different authors (U. Schaffner, B. Strebel, Niederer+ Pozzi, K. Wehrle, Windmoser, R. Schrämli, Andres Strebel) according to the project. The selection is made by Paula Troxler and Bruno Strebel.

The card on page 36 to 38 is made by Paula Troxler in May 2008 in cooperation with B. Strebel.

The cover is a drawing of the Assaboll lake and surroundings, view from the top of Kinkintay, Paula Troxler, November 2007.

The frontcover is a map of ‘Horn of Africa’, Ethiopia with neighbour countries and the position of the ADDA project, Paula Troxler, May 2008.
The water distributing system of the Assabol dam is the topic of these photographs: tunnel construction at the Musea, main pipe at diversion, plots of land waiting for water, drip irrigation and hose irrigation. Gardening starts.


Drawing page 25: View to Alitena, drawing at Bagali Badena. You can see the bridge to Alitena, Bare Are (parish house) and the church in the back, Paula Troxler, November 2007.

Drawing page 26/27: Drawing at building site Assabol. You can see the wall, the lake, pipes, compressor, concret mixer and cable cran, Paula Troxler, November 2007.

Drawing page 29/29: Drawing of the garden beside Assabol. This garden is irrigated by water of Assabol. Every family of Dawhan will have a piece of irrigated land to plant fruits, vegetables. Paula Troxler, November 2007.

Drawing page 30: Drawing of Musea tunnel. The pipe goes through the rock to Gammada, Paula Troxler, November 2007.

Drawing page 33: Drawing of Kitra. The pipe is coming from the mountain Kitra to the riverbed. The pipe is hanging, Paula Troxler, November 2007.

Drawing page 34: Drawing of a cornfield irrigated by Assabol. Behind the maize you can see the tap to take the water, Paula Troxler December 2007.


Drawing page 44: Drawing of the market place in Adigrat, where you can see different fruits and vegetables which could be planted in the gardens at Assabol, Paula Troxler, December 2007.
Large amount of water, dam and lake in 2006 and 2007. Overflow in summer 2007, lowering lake by drain pipe in 2007, and overflow with open sluice gate conduct in 2006. Several dam views are taken from the crane bucket or boat.

Water colour is changing from light brown during floods, to dark during the dry season. A duckweed carpet (Lemna, aquatic plant) floats with the wind on the lake.

Several members of the construction crew are depicted. The demonstration garden under open channel is visible in the centre of the page. Dam crown with winch tower and wingwall are completed.
The installation of filter pipes and sluice gate shaft was only possible after emptying and drying up of the entire reservoir in April 2008. The work on the shaky platform proved to be a challenge. Visit of Caritas Switzerland crew in January 2008 at the parish in Ingal.

Celebrating the opening of the jammed sluice gate in April 2008; impressions from sedimentation and mud deposits behind the dam. Wyssen cable crane in operation.

Several pictures show the mud deposits from the rainy season 2007 and the time of blocked sluice gate. 8 meters sediments have been deposited. In the heat of the sun the formerly liquid slurry dried and started to crack. People utilise the time of empty lake for the felling of submerged trees.