Introducing rural business development services to maximize the impacts of mini hydropower plants in Indonesia

INTRODUCING RURAL BUSINESS DEVELOPMENT SERVICES TO MAXIMIZE THE IMPACTS OF MINI HYDROPOWER PLANTS IN INDONESIA

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1. Background and Objectives of the Study

The Indonesian government places high priority on an ambitious rural electrification program aimed at reducing economic imbalances and social disparities between urban and rural areas by improving equity in the distribution of electricity. However, due to the sheer size and the fragmented structure of the archipelago, the Indonesian government has had to lower its target of electrifying all villages by 2004 through centralized grid expansion programs. It is now foreseen that at least 3000 villages will not be reached by the national grid until 2019. These areas have been determined target areas for decentralized electricity generation programs. The use of renewable energy technology has particular applicability in these remote rural areas, where it can make use of locally available resources, such as sunlight, biomass, wind and hydropower.

The present paper summarizes the main findings from my PhD thesis which focuses on experiences made with decentralized village hydro-electric power plants with plant capacities ranging from 5 to 100 kW. Such plants are also called mini hydropower schemes or just mini hydro schemes. The study attempts, both, to contribute to basic development research and to provide practical solutions to improve project impacts. The core objective of the study has been to address the weaknesses in the current approach to mini hydro development which largely failed to attain sustainable development impacts. The study has been intended to deliver a new approach offering practical solutions to the known problems of mini hydro operation and the promotion of productive electricity uses. Compared to other project-

oriented applied research,[1] the study is different not only in that the insight gained served to develop a new approach but that this approach was experimentally applied in an actual project involving a village-owned coffee roastery. This allowed the recommendations to be verified and meant that the practical experience gained could be used to improve the approach.

Compared to other renewable energy technologies, harnessing mini hydropower offers the advantage of using the generated electricity for power-intensive productive purposes. Similar to other rural electrification projects, mini hydro programs are linked with a multitude of expected benefits. The following expectations have been extracted from a project document of the Deutsche Gesellschaft für Technische Zusammenarbeit GmbH currently implementing its "Program for the Environmentally Friendly use of Mini Hydropower" (GTZ-MHP) in Indonesia.[2] The mini hydro schemes should be operated reliably and sustainedly and should contribute:

- to the emergence of small businesses;
- to the improvement of the situation of women;
- to protect the natural environment;
- to income generation based on profitable plant operation;
- and, finally, to the improvement of living conditions in terms of higher incomes and more job opportunities.

GTZ is active in the Indonesian mini hydro sector since 1988. The program was particularly successful in the field of technology transfer. By the end of 1996, 40 mini hydro schemes had been installed and two companies established capable of designing, producing and implementing schemes independently. These companies had developed another 40 schemes by 1999 with financial support from the Indonesian government and international donor organizations. Despite these successes, a growing number of constraints were

1 Project-oriented applied research has steadily gained importance in geographic development research since the 1980s. A huge variety of research fields makes geography a discipline which is increasingly requested particularly for planning purposes (see SCHOLZ AND MÜLLER-MAHN, 1993). However, this seemingly ideal cooperation is not without problems. MÜLLER-MAHN (1998:21), for example, notes that the relationship between development research and development policy fluctuates between critical distance and total rejection. Reasons for this situation are not seen in a lack of willingness to cooperate but in different institutional interests, working constraints, personal perspectives and ways of thinking.

2 GTZ, 1998.

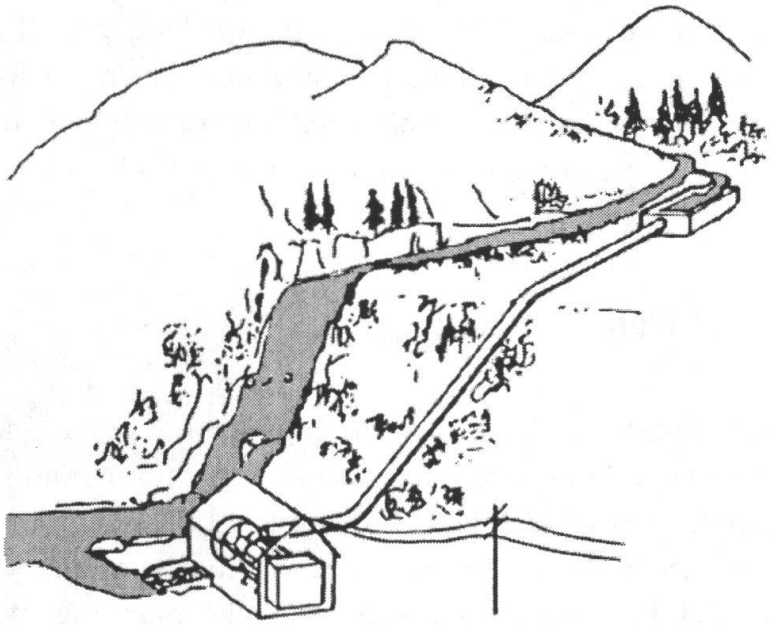

Figure 1: Possible Layout of a Mini Hydro Scheme[3]

Figure 2: Medium-head Mini Hydro in Cicemet, Indonesia[4]

3 Source: FRAENKEL et al., 1991:31.

4 Photo: T. Meier.

recognized to exist as more experiences were reported by the village communities operating the schemes. The electricity was hardly used for productive purposes and low load factors limited the revenues generated from electricity sales. Therefore, most expected benefits did not materialize. It also emerged that many plants stopped operating after a short period.

2. Methods of Data Collection

Different research methods have been used to gain a better understanding of the various factors influencing mini hydro operation and electrification impacts. A comprehensive review of the literature, focusing on international comparative studies of rural energy sector interventions, provided the required theoretical background and supported the planning of the empirical work in Indonesia. The GTZ mini hydropower development program (GTZ-MHP) was chosen as research object offering a direct practical reference.

Figure 3 illustrates the qualitative research process underlying the study. The research design has been derived from the model of a circular research process by Flick.[5] This model has been modified to indicate that the present study is more accurately described as a process oscillating between the three levels of data collection, analysis and theory.

Most of the empirical data were collected during the first and second field visits in February/March 1999 and August/September 1999. Twelve mini hydro locations in West Java, East Java and West Sumatra were visited during these periods (see Figure 5). For seven locations, a separate case study was formulated, each similarly structured. The data collection at the mini hydro locations was based on a variety of Participatory Appraisal (PRA) tools as described by MacCracken et al. and Schönhut and Kievelitz.[6] Each visit followed a similar research pattern: Upon arriving at a village, the first person contacted was the village head. After the intention of the visit was communicated, a transect walk was conducted from the village to the powerhouse. During these transect walks it was possible to make observations and to informally talk with villagers and plant operators. The impressions gained during the transect walk were recorded later in a research diary and provided a

5 FLICK, 1995:61.

6 MACCRACKEN et al., 1988; SCHÖNHUT and KIEVELITZ, 1993.

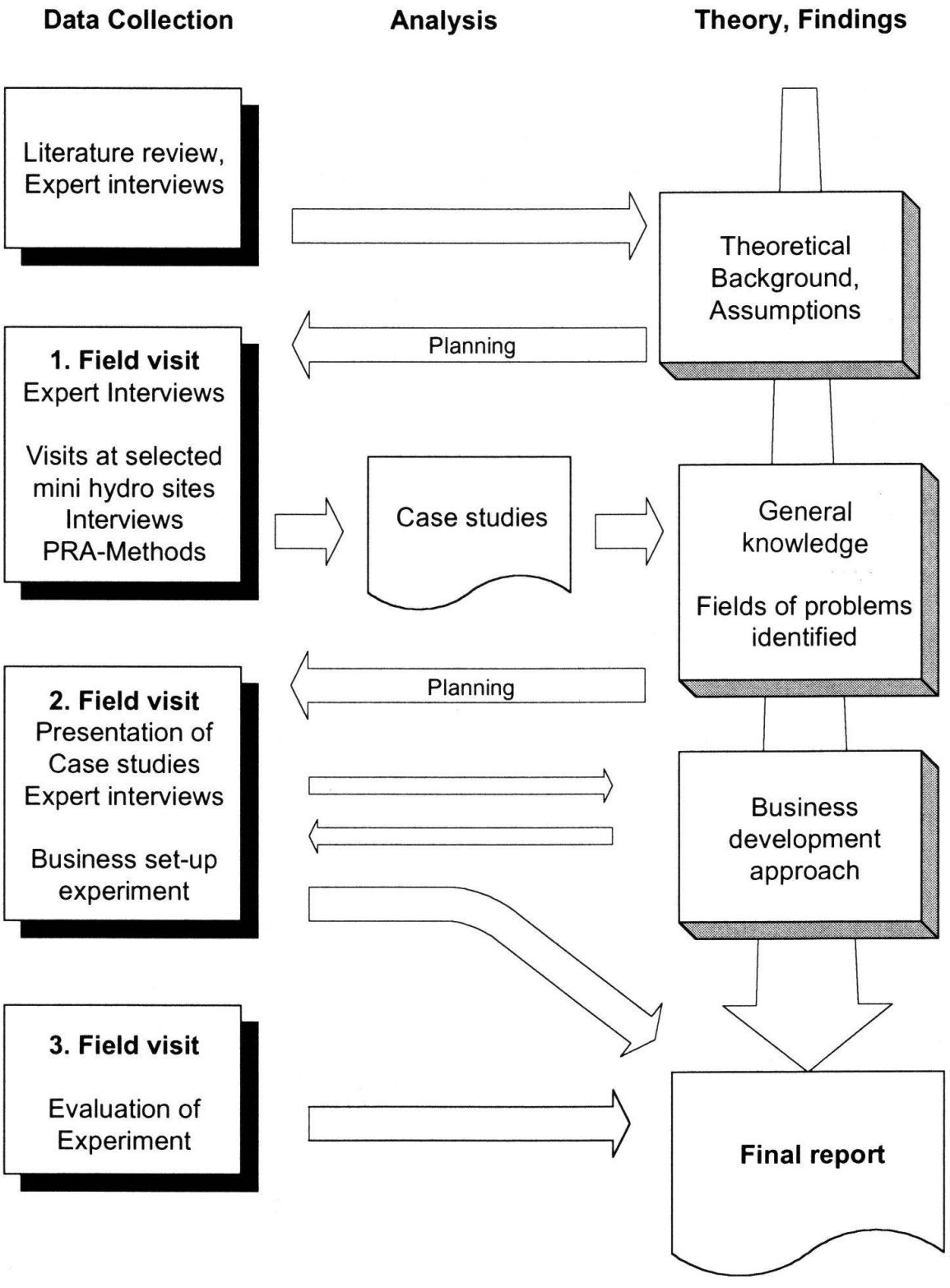

Figure 3: The Research Process[7]

7 Source: MEIER, 2000.

good overview of the general situation in the corresponding village and the state of the power plants.

During the following days, semi-standardized interviews with household members were conducted. Most interviews turned out to be group discussions with a number of family members and/or neighbors. Entrepreneurs were selected as key informants with regard to local economies, marketing potentials, product prices, as well as possibilities and constraints on productive end-uses of electricity. Different questionnaires were compiled for interviewing households and entrepreneurs. Most parts of these questionnaires were non-standardized containing open questions guiding the interview sessions. During the first site visit, both questionnaires were tested and improved. The interviews were conducted in *Bahasa Indonesia.*

The visits at the locations took between 3 and 5 days. The author and assistants commonly stayed at the house of the village head. The opportunity to join groups of villagers was used whenever possible to talk informally about a variety of things. This also allowed crosschecking the information received during formal data collection. The information was generally also crosschecked with experts when returning from field visits.[8]

The findings of the case studies only allowed the formulation of assumptions about the reasons why productive electricity uses were virtually absent. The formulation of a business development approach, however, requested a more profound understanding of the situation. The author therefore decided to conduct a business set up experiment to closely experience the actual constraints hampering the emergence of productive electricity uses. GTZ-MHP agreed to financially support the endeavour. The motivation to choose this method was gained from Hernando DeSoto's work about the informal sector in Peru where it was attempted to experimentally establish an enterprise to investigate and document the handicaps imposed on people willing to start their own business.[9] The experiment was started during the second field visit in August/September 1999 and continued beyond the third field visit of July/August 2000.

8 The importance of crosschecking cannot be overemphasized. It often happened that the author had quite a different perception of a situation after having discussed the findings with experts who were able to provide much broader interpretations.

9 DESOTO, 1989.

3. Justification of Mini Hydropower Projects

Justification and objectives of mini hydropower projects, like other rural energy development projects, are rooted in the discussion about energy related problems in rural areas. The discussion suggests that the characteristic living conditions of rural areas in developing countries and the development problems linked to them are expressed in typical rural energy consumption patterns. Figure 4 shows the result of a World Bank study concerning the relationship between per-capita income and the amount of biomass in total energy used. If per-capita incomes are below US$ 300 per year, the percentage of biofuels commonly exceeds 90%. It is clear that relating energy use patterns solely to per capita income or household incomes is a simplification of a more complex reality. However, the fact is that approximately one-third of all energy consumed in the developing world derives from the burning of wood, crop residues, and animal dung.[10]

Such energy consumption patterns result in a number of disadvantages, which negatively affect the development process of a rural society. The gathering of biofuels takes up a great deal of time which is spent at the expense of education and productive activities. Indoor air pollution created by such cooking fuels is a health hazard particularly for women and children. Biofuels, in addition, are characterized by lower energy efficiency compared to modern fuels.[11] Commonly, the poorest classes in developing countries are most affected by these problems. Hence, it is the poor who pay a higher price for energy than the relatively better off. Therefore, it is assumed that rural energy projects also contribute to poverty alleviation.

After disappointing experience with, both, supply-side and demand-side energy strategies (see Box 1) it was recognized that the mere improvement of energy supply does not lead to the expected developments. In particular there was no significant contribution to poverty alleviation observable.[12] It is therefore recommended that rural energy interventions, to be successful, should not be focused on energy alone but to consider various economical, technical, institutional and cultural factors in project identification, planning and implementation.

10 WORLD BANK, 1996:20.
11 BATLIWALA, 1995.
12 GOLDEMBERG et al., 1995.

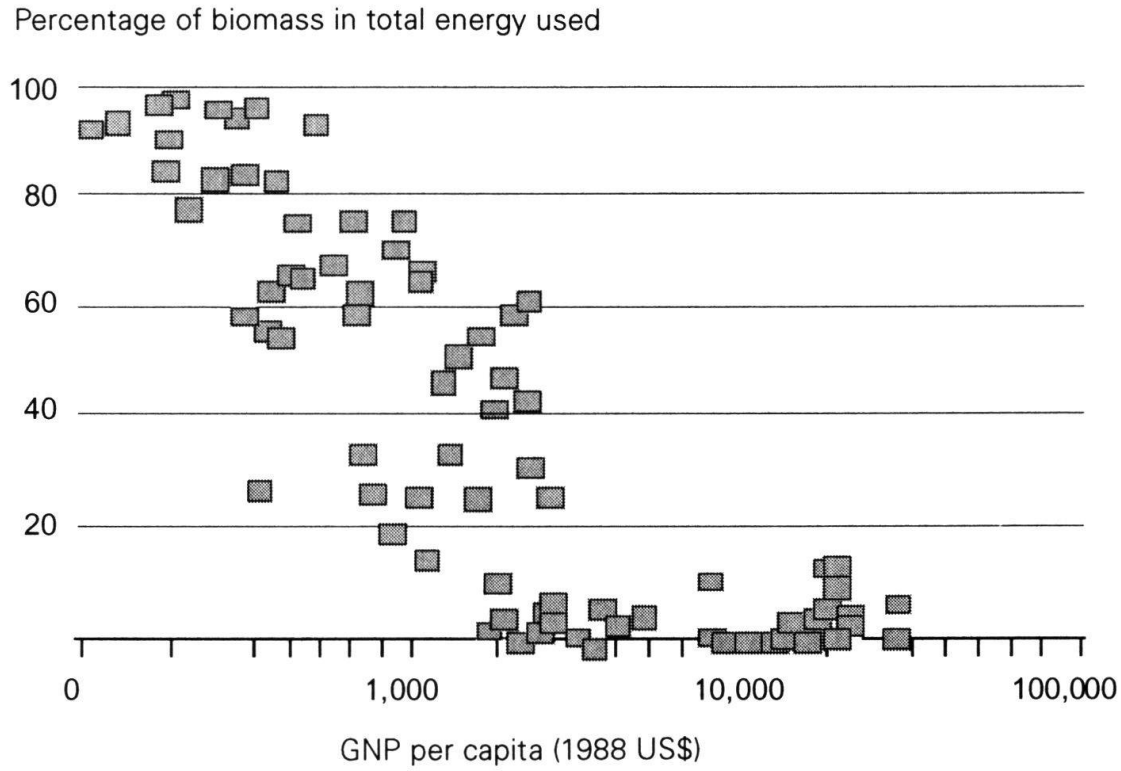

Figure 4: Use of Biomass in Relation to GNP per Person in Eighty Countries[13]

4. Characteristics of Mini Hydro Locations Studied

The common characteristics of the twelve mini hydro locations visited were given by their spatial isolation in agriculturally dominated rural areas. All villages consisted of a number of dispersed hamlets which resulted in high costs for the transmission lines and considerable power losses due to voltage drops in the grid. At the time of data collection, four of the twelve mini hydro schemes were not operating as a result of technical and institutional problems. At seven of these locations in-depth case studies were conducted. Table 1 shows some large differences between main indicators at different mini hydro locations. In particular the number of hamlets electrified, the household electrification ratio and the kW-unit cost of the system.

13 Source: WORLD BANK, 1996:40.

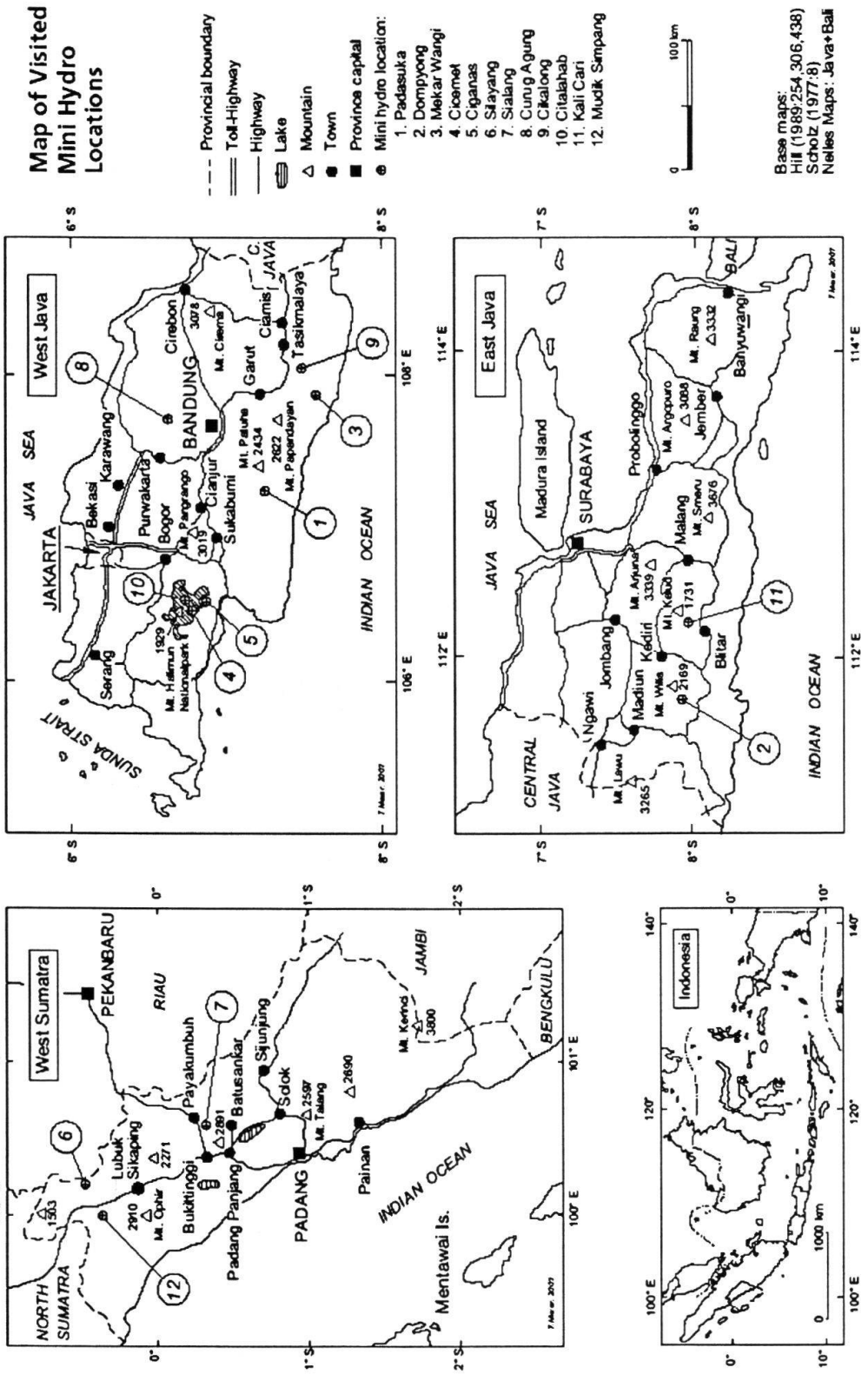

Figure 5: Maps of Visited Locations

Box 1: The Theoretical Background of Rural Energy Strategies

Rural energy development strategies are influenced by the discussion about development in general and about rural development in particular. As development priorities have been subject to various changes during the past four decades (see GEISER, 1993), so have the energy strategies. Concurrently, there is no predominant development theory of global scope and a variety of different theories exist simultaneously. It is therefore not possible to clearly attribute the different strategies to single theories but it can be distinguished between *supply-side* energy strategies and *demand-side* energy strategies (ADB, 1991:1ff.).

Supply-side energy strategies are based on theoretical concepts of modernization which are rooted in the 1960s. Their main objective is economic growth and it is believed that the benefits of growth will also trickle down to the lower classes of the society. Projects are justified with the empirically found correlation of per-capita energy consumption and economic growth. Thus, it is concluded that an extension of modern energy supply will automatically lead to economic growth. Large-scale rural electrification projects based on grid extensions fit into such approaches.

Disappointing results with modernization strategies and growing environmental consciousness led to the development of demand-side energy strategies which are based on the basic needs approach, on the concept of participation and on the strategy of sustainable development. The objective of such strategies is to contribute more directly to poverty alleviation by addressing the actual energy consumption patterns while simultaneously considering local and global scale environmental and economic issues. The promotion of energy efficiency improvements like improved wood stove programs and the promotion of centralized and decentralized renewable energy technologies like photovoltaics and mini hydropower fit into such approaches.

5. Evaluation Results

The findings of the case studies were used to evaluate the mini hydro projects, both with regard to the aforementioned donor expectations and to the electrification impacts perceived by villagers. The main findings are summarized in Table 2.

From a donor perspective, expectations have not, on the whole been met. The reliability of electricity supply is unsatisfactory at most locations, preventing entrepreneurs from investing in electrical equipment. Electricity is therefore mainly used for individual consumption rather than productive purposes. None of the mini hydro schemes is run profitably because of low load factors, high operating costs, low electricity tariffs, sub-optimal rate col-

Table 1: General Data and Specific Indicators of Mini Hydro Sites Visited

Note: Costs were calculated based on a pre-crisis exchange rate of Rp. 2'200 per US$ revenues are calculated on a post-crisis exchange rate of Rp. 8'000 per US$

	Padasuka	*Dompyong*	*Mekar Wangi*	*Cicemet*
Population data				
Inhabitants	6'135	3'685	4'281	4'500
Households	1'462	876	1'047	1'050
Electrification data				
Commissioning year	1994	1994	1995	1997
Mini hydro capacity [kW]	48	27	58	60
Hamlets electrified	3 of 8	2 of 4	3 of 3	34 of 36
Household electrification ratio	10%	20%	38%	95%
Operational?	yes	yes	no	no
Project costs				
Total costs [US$]	128'000	73'000	121'000	100'000[14]
US$ / kW	2'670	2'700	2'090	1'670 (2580)
Revenues (if operational)				
Annually collected [US$]	900	975	1'200	3'900

	Ciganas	*Silayang*	*Sialang*
Population data			
Inhabitants	3'893	1'951	1'453
Households	995	390	360
Electrification data			
Commissioning year	1998	1997	1993
Mini hydro capacity [kW]	80	16	7
Hamlets electrified	13 of 17	4 of 4	–
Household electrification ratio	51%	20%	–
Operational?	yes	yes	no
Project costs			
Total costs [US$]	50'000	75'000	13'500
US$ / kW	625[15]	4'690	1'930
Revenues (if operational)			
Annually collected [US$]	2'475	1'200	–

14 155'00 if estimated value of community work, which was provided for free, is included.

15 The low figure is the result of the financial crisis. GEF payments were made in the period June-July 1998 when the rupiah was traded around Rp. 15'000 per US$.

lection and non-compliance with existing regulations. On the negative side the programs have enlarged disparities between high and low-income families because the latter are commonly excluded from having an electricity connection. The socio-economic impact of the GTZ program has therefore been limited. In particular, the number of jobs created through productive electricity use was found to be insignificant.

Despite limited attainment of donor objectives, the beneficiaries of mini hydro programs considered their living conditions improved.[16] Probably the most important finding was that electrification gives rural people an enormous psychological boost as they associate electricity with modernity. They were proud of their villages now having electricity, narrowing the perceived gap between rural and urban areas. Increased security and less dependence

Figure 5: Children Watching TV in Ciganas, West Sumatra[17]

16 The positive evaluation by villagers may seem to contradict the finding that plants are not run reliably. It needs to be said that villagers had pre-electrification experiences with electricity by operating water wheels and using car batteries to operate consumer electronics. Such uses even flourish if plants are down. Some answers by villagers must therefore be interpreted with regard to electricity supply in general.

17 Watching TV is the second most frequent end-use of electricity after electric lighting. Villagers are happy to be able of watching TV which is considered as modern. Prior to electrification TV has been restricted to high-income families. Photo T.Meier.

Table 2a: Main Findings from Project Evaluations

Evaluation with Regard to Donor Expectations	
Reliability of electricity supply	In most cases unsatisfactory due to very long downtimes, frequent power interruptions, and voltage and frequency fluctuations.
Productive electricity use	Electricity is scarcely used for productive purposes. Most frequent end-use is the production of sweetened ice in freezers. Electricity does not automatically trigger new businesses – additional inputs are needed.
Situation of women	No obvious impacts on the social role of women. No improvements of health hazards caused by indoor air pollution because fuelwood is not replaced by electricity.
Natural environment	Mini hydro technology is basically environmentally friendly. Impact to counteract global warming is negligible as long as the installed mini hydro capacity remains very small.
Economic viability of plants	Plants are not run profitable due to low tariffs, low load factors, frequent downtimes, limited plant capacities, overstaffing, corruption and fraud. Revenues are too small for proper maintenance and renewal of equipment, thus preventing sustainable plant operation.
Living conditions (income and employment)	Negligible impact on employment because electricity is scarcely used for new productive purposes. Income situation of electricity consumers slightly improved because of reduced spending for kerosene and batteries. Since only better-off household are electrified, income disparities between villagers have grown.

on daylight, access to mass media and village life were all mentioned as having improved the quality of their lives.

The findings made in Indonesia are largely in line with international experience. Generally, there are serious doubts over the realization of the various benefits of rural electrification formulated by donor agencies. Most of these benefits have been judged as exaggerated expectations of the contribution that mini hydropower could make to rural development.

Table 2b: Main Findings from Project Evaluations

Villagers' Self-Evaluation	
Living conditions (relative to urban areas)	Gap between rural and urban areas is perceived as having narrowed due to the availability of electricity. Villagers perceive living conditions as improved.
Quality of life	Electricity is perceived as easy to handle, making life more comfortable. Increased security and night life due to public lighting. Women enjoy electric lighting in the kitchen making cooking easier and freeing their time for other activities.
Productivity	Traders report sales and profit increases due to extension of product ranges (light bulbs, wires, consumer electronics, and new products villagers learned from TV commercials) Increased productive output in households active in small handicraft as electric lighting allowed extended working hours.
Education	No electricity use in public schools but improved religious teaching in Islamic evening classes due to electric lighting. Perceived improvement of general education due to access to mass media.
Customs / Traditions	Impact of TV by some people feared as displacing traditional values.
Conflicts	Electricity demand growth quickly exceeds plant capacities. Electrification ratios remain low, causing disappointment among non-consumers. Conflicts and sabotage of plants have been reported.

Figure 6 shows the mini hydro plant in Mekar Wangi, West Java at the day of commissioning. Inappropriate management turned the plant very soon into a ruin. The picture below shows the sad state of the plant five years after commissioning. The terrible situation is also a result of a small-scale village revolution which brought down the despotic village head of Mekar Wangi. Villagers destroyed the plant which they symbolically associated with the oppression by the former village head.

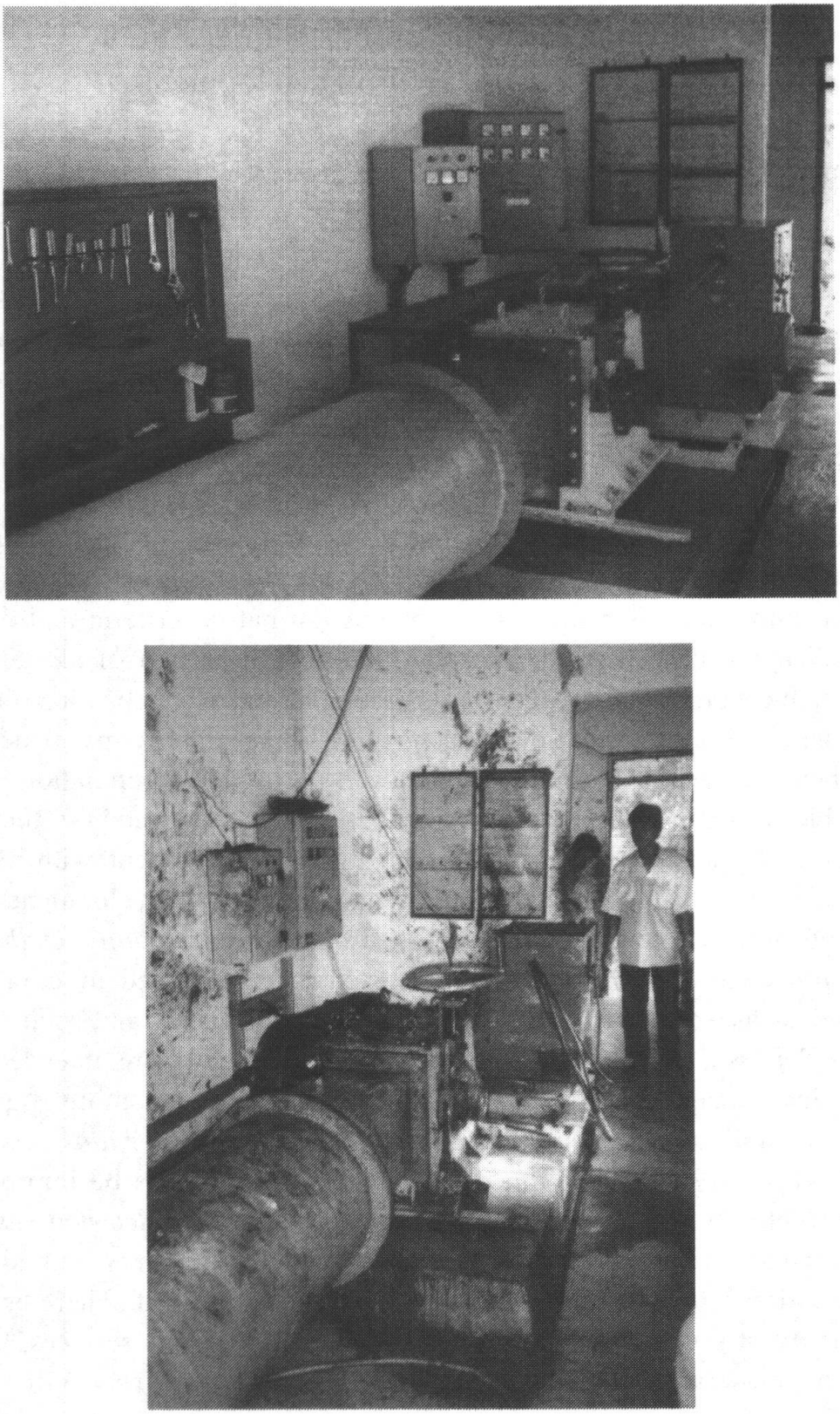

Figure 6: Unsustainable Plant Operation. Above: 1994,[18] below 1999

18 Photo: Hidro Daya Kinerja. April 1994. Photo T. Meier: September 1999.

6. Recommendations to Address Shortcomings in the Current Approach to Mini Hydro Development

The study has revealed clear differences between village-perceived project impacts and those expected by donors, the result of applying different criteria to assess the success of improving living conditions. In other words, villagers and donors have a different understanding of the term development. Although the concept of participation enjoys considerable popularity in today's technical assistance vocabulary, development objectives are still predominantly formulated by donor agencies. This means that the concept of development is still defined from a western viewpoint, as has been the case since the early 1960s. The target group's idea of development is seldom assessed, which is why they show little commitment to contributing to certain objectives. When living conditions are defined, relative differences are more important to people than obvious normative criteria and development indicators. It needs to be accepted that poverty is first of all defined by villagers, and not by donor agencies. Although rural electrification may not contribute significantly to alleviating poverty in absolute terms, it definitely does when it comes to the poverty perceived by the local population.

Table 3 summarizes the recommendations made to address the shortcomings in the current approach to mini hydro development with regard to sustainable and reliable plant operation and industrial development. Many operating problems could be avoided with broader *feasibility studies and project planning*. Up to now, feasibility studies have tended to concentrate on technical aspects to the near exclusion of institutional and socio-cultural aspects. This is a grave oversight if mini hydro schemes are intended to be community managed. For mini hydro projects to have a more significant impact on rural development the household *electrification ratios* need to be higher and the *reliability of the electricity supply* needs to be improved. A reliable electricity supply is a precondition for *productive electricity use*. The recommendations particularly stress that a village community should not be left alone after a mini hydro scheme has been commissioned. There is a need for a variety of services to be provided, in particular repair services, business development services and financial investment incentives. Without the availability of such services mini hydro schemes cannot be expected to operate on a sustained basis. To be able to pay for such services, the *financial performance* of mini hydro plants needs to be improved, for example by

linking productive end-uses to mini hydro operation in combination with an improved audit of management committees.

7. SIAM – A New Market-oriented Approach to Maximize Electrification Benefits

The creation of jobs through productive end-use of electricity would be a very effective means of alleviating poverty. However, creating jobs is a difficult task, especially in isolated rural areas characterized by numerous constraints on human resources, access to capital and infrastructure. Electricity supply may alleviate some infrastructural constraints, but linking job creation to productive end-use of electricity generated by mini hydropower plants in very isolated rural areas is an extremely delicate, multifaceted challenge.

Despite these constraints, the author was able to design a new market-oriented approach to mini hydro development based on the above findings and recommendations. It was named the SIAM approach, which stands for Symbiotic Integration of Agroprocessing and Mini hydro operation. The main objectives of the SIAM approach are to improve the reliability of electricity supply, to promote productive electricity uses and to achieve a more equitable distribution of benefits among villagers living at mini hydro locations. It is based on the following principles:

- Productive activities are linked with mini hydro operation to improve the reliability of electricity supply and to provide an additional revenue basis for village development activities.
- Business-like organizations offer need-oriented services to assist village communities with the set up and management of businesses.
- Donors provide incentives to address unfavorable rural investment conditions during the start-up phase of businesses.

Figure 7 illustrates the core principles of the new approach. The main difference from the current approaches to mini hydro development is that *productive activities are no longer considered an effect of a mini hydro project but a precondition for sustainable plant operation.* Productive activities provide the additional basis for revenue urgently required for appropriate maintenance and thus sustainable plant operation. Revenue surpluses can be used for village development activities.

Table 3: Summary of Recommendations

Broaden Feasibility Studies and Project Planning	1. Provide villagers with information about possibilities and limitations of mini hydro plants prior to a project to avoid subsequent disappointments. 2. Avoid that certain clans become dominant over a plant to ensure a more equal distribution of benefits and to reduce the potential of conflicts. 3. Accompany the setting up of mini hydro management committees until the new organizations work properly. 4. Dare to postpone a project if rampant corruption is obvious and if no agreement about a future management committee can be reached.
Increase Electrification Ratios	5. New financing schemes should enable the construction of larger plants which better exploit the available hydropower potential. 6. Encourage villager's participation in construction works by promising a connection to those households participating. 7. Provide credit for those not capable to pay connection costs so as to not exclude low-income families. 8. Metered tariffs should be promoted for reasons of fairness and to avoid waste of valuable plant capacity.
Improve Reliability of Electricity Supply	9. Repair services are needed to improve supply of spare parts thus reducing downtimes. 10. Safety switches should prevent air-cooled ballast elements from burning through. 11. Electricity should be transmitted at higher voltage to distant hamlets to reduce capacity losses and voltage drops.
Promote Productive End-use	12. Provide risk-reducing incentives for investments at remote areas. 13. Identify productive end-uses during feasibility studies and consider end-uses in the system layout. 14. Provide business development services to address the various constraints faced by rural entrepreneurs. 15. Support the development of (electrically operated) process technology packages, particularly in the field of agroprocessing. 16. A separate grid would be useful to supply electricity to centers for small industrial activities during the day.
Improve Financial Performance	17. Link at least one promising productive end-use with mini hydro operation to assure that the financial returns can guarantee proper operation and maintenance. 18. Management committees should become accountable to independent auditing bodies to avoid embezzlement of revenues. 19. Upon commissioning of a mini hydro plant, committees should have liquid means for annual operation and maintenance costs amounting to around 3% of initial investment costs.

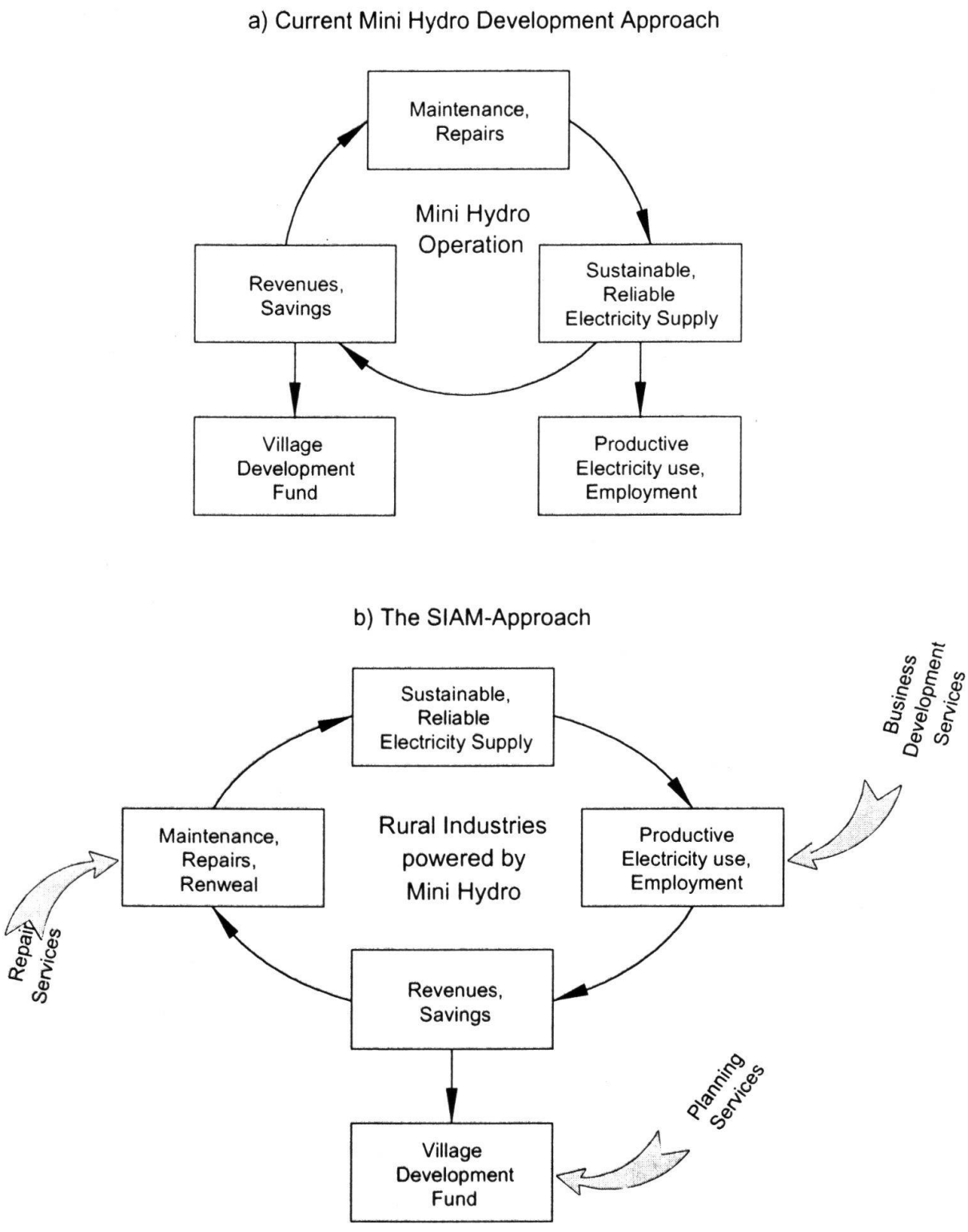

Figure 7: Integration of Mini Hydro Operation and Productive Electricity Use.[19] Above: Current Mini Hydro Development Approach. Below: The SIAM-Approach.

19 Source: MEIER, 2000.

If village communities are expected to keep technical systems in action, they need to have access to a variety of support services. The SIAM approach proposes establishing a working relationship between a village community and an in-country partner able to provide services directly, or at least act as an agent between a village community and other more specialized service suppliers. In accordance with the business development services approach (see Box 2), services offered have to be need-oriented, which can best be achieved if the services are provided by a business-like organization trying to achieve financial self-sustainability. This means that a village community is supposed to pay for the services they receive to guarantee both their high quality and the cost recovery for the service supplier. Service suppliers are not expected to recover their cost by pre-defined service fees. They may find their own innovative ways to generate income, e.g. by becoming shareholders of village enterprises, working on a profit-sharing basis, or by trading the products from rural businesses, etc.

The SIAM approach focuses on agroprocessing as the main business activity to be supported. Agricultural products are commonly sold unprocessed on the regional market through local traders. The more isolated a village, the lower the farmgate selling prices due to high transportation costs.[20] Therefore, the more isolated an area, the more it makes sense to process agricultural products on the spot because most of them loose bulk and weight during processing, meaning they can be transported at much lower costs. What is more, the value-added would remain in the villages and could be used for village development activities. Other positive socio-economic impacts derive from forward and backward linkage effects.

Service suppliers are expected to provide information about agroprocessing applications and technology which can be reasonably employed in rural areas. They may also organize training in improved cultivation techniques and the quality control of raw materials and end products. It would also be possible to offer marketing services, particularly where regional distribution is concerned. In the case of a new mini hydro plant, the setting up of an agroprocessing industry would best be included in the plant's initial business plan, making a project more readily bankable.

Since unfavorable rural investment conditions also apply to service suppliers, there need to be financial incentives to attract their interest in remote rural areas. There may be lump sums offered for a project start-up,

20 BRAUNS, 2000:111.

soft loans to address liquidity problems, attractive rewards for successes, etc. The important point is that incentives will only reduce the risk but not eliminate it entirely. If all risk were eliminated, then support services would soon resemble inefficient public extension services.

The remainder of this paper provides details about the business set up experiment. As mentioned earlier, experience gained during this experiment strongly influenced the formulation of the SIAM-approach.

8. Setting up a Coffee Roastery Based on the SIAM-Approach

The investigation of selected mini hydro locations revealed that only poor impacts had been achieved concerning the emergence of productive electricity uses. It was therefore decided to conduct a business set up experiment to find out more about the actual constraints hampering the emergence of productive electricity uses. The first problem to be tackled was to select a mini hydro location suitable for such an experiment. The plant had to have two main characteristics: Firstly, it had to be operational with a functioning automatic load controller to guarantee the required electricity quality for productive purposes, and secondly, the plant should have been operated during nighttime only, allowing the introduction of productive electricity uses during the day. Only one (!) of the twelve mini hydro locations visited fulfilled these criteria. Thanks to the repair services organized by a regional GTZ project, the mini hydro in Silayang, West Sumatra—found to be an interesting location because it was the only place where a mini hydro plant was managed by a village-owned electricity company (PLDS)—had just recently been put back into operation.[21] Thus, a successful business set up may have also served as a showcase to support the government's attempts of regional decentralization.[22]

21 GTZ-Area Development Project for the Rehabilitation of Critical Land and the Protection of Natural Resources and Environment (GTZ-ProRLK). The project was closed in March 2001.

22 Article 108 of law no. 22/1999 on regional decentralization (GoI, 1999) mentions explicitly that rural villages may establish their own business entities. Revenues generated may become part of the official village revenues to be managed through the village revenues and expenditures budget (Article 107).

Box 2: Business Development Services

Since the late 1980s, there has been an explosion of interest in how small enterprises (SEs) can help provide jobs, alleviate poverty and ensure basic needs satisfaction. Through path-breaking studies, the importance of SEs has been documented in both developing and industrialized countries (see Hernando DE SOTO 1989).

Other reasons for the shift of focus on SEs were corporate restructuring and privatization efforts in industrialized countries and eastern European countries undergoing a transition from socialism to market-oriented economies. In some cases these efforts created new business opportunities for smaller firms. However, most people had to abandon expectations of life-long employment in the corporate sector or state companies, leaving them scrambling to find other means to sustain their livelihoods. For the workers in both economies, "... employment in SEs has become a necessity, if not a means of economic salvation" (BARTON, 1997:1).

In the face of this growing understanding of small enterprises, development programs have begun to focus on ways of promoting SEs. In many countries, microfinance programs were launched and achieved considerable successes. On the other hand, studies of constraints faced by SEs (e.g. MEIER, 1997) have indicated that other factors, particularly in the field of human resources (management know-how, technical skills) and market access may be as important as, or even more important than financial constraints. Recognizing the importance of these other factors, institutions promoting SEs have been searching for ways of providing non-financial services like training, consulting, marketing, technology development and dissemination. Such services are commonly referred to as Business Development Services (BDS).

Governmental organizations were found to be ineffective in providing such services. Those they did provide were of low quality and did not address the needs of SEs. As a result, new market-oriented approaches gained momentum. It was concluded that service suppliers would best be organized as small businesses to ensure demand-orientation of services offered. Swisscontact, a Swiss foundation for technical cooperation, was one of the pioneers to support the setting up of such Service Centers in Indonesia from the mid-1990s. These Centers need to generate income by selling services to SEs. The willingness of SEs to pay for services is considered an indicator of quality and need-orientation of products offered. The self-sustainability of the Service Centers, in turn, shall guarantee continuity of small enterprise promotion beyond donor support.

The experience so far showed that private sector service suppliers find it difficult to achieve financial self-sustainability through the collection of user fees alone (STANTON AND BOULTER, 2000; GOLDMARK, 2000). It is concluded that service suppliers need to diversify their income sources, including a range of other business services that cross-subsidize BDS or other funding streams, e.g. membership subscriptions. However, leading experts emphasize that the income of service suppliers should still exclusively come from SEs and not from sponsorship. Otherwise, service suppliers would soon shift their focus on the more attractive market of donor funds.

During the first field visit to Silayang in February 1999, the villagers already expressed their wish to process coffee. Most families of Silayang cultivate coffee and sell the green coffee beans via local traders on the regional market from where they are supplied with roasted ground coffee. The price difference between unprocessed and processed coffee is around 300%, a considerable value-added that would remain in the village, if coffee were processed locally. The villagers originally wished to get an electric coffee grinder because they thought that coffee grinding would be the process responsible for the final value of the product. They thought that every family could easily roast coffee in their own frying pans. The author, coincidently having some background in the coffee processing business, could point out that roasting is the important process responsible for more than 90% of the value added. Thus, roasting must be considered the process that needs to be mastered. This experience indicates how important information services are in case of rural agro-industries.

After several meetings, the villagers decided that the roastery should become a separate village-owned enterprise acting as a wholesaler supplying packaged ground coffee to retail shops and local traders, thus benefiting from existing marketing relationships. The coffee roastery will be linked with the village-owned electricity company (PLDS) by contributing to the maintenance cost of the mini hydro as well as to enable the renewal of the plant in the long-term. To ensure a continuous supply of business development services, the village government signed a three-year agreement with LPWAL,[23] a non-governmental organization (NGO) providing consultancy in the fields of accounting, marketing and coffee processing. Services will be paid for by a 15% share of the gross profit.

Figure 8 shows the structure of these two enterprise units. The dashed line between the two units indicates their liaison. The structure is an interpretation of the decentralization law no. 22/1999.[24] Article 101 says that the duties and obligations of the village head, among others, include the economic development of the village. It was therefore concluded that the village government should be at the top of a village-owned enterprise entity, being responsible to the village representative board (village parliament). The manager of the roastery will submit regular reports to the village

23 The Women, Child and Enviroment Care Institute (LPWAL) is based in Padang, West Sumatra and was founded in 1999 by a former staff member of GTZ-ProRLK.

24 GoI, 1999.

government concerning the operational and financial performance of the roastery. The village parliament as supervisory body will have the task to check these reports to guarantee the legitimacy of the roastery's operations.

The idea of the experiment was not to interfere in activities which could be conducted by LPWAL because the main objective was to learn about constraints on rural business development (including constraints affecting service suppliers). Only if the experiment came to a halt was it intended to provide further input. To set up a proper business plan LPWAL had to collect additional data, in particular concerning the annual coffee production in Silayang and the surrounding villages, the local and regional market potentials and the definitive location of the coffee roastery after a women's organization opposed the location near the mini hydro.[25] However, the experiment immediately came to a halt after the author had left Indonesia in September 1999 and no activity was conducted until end of June 2000.

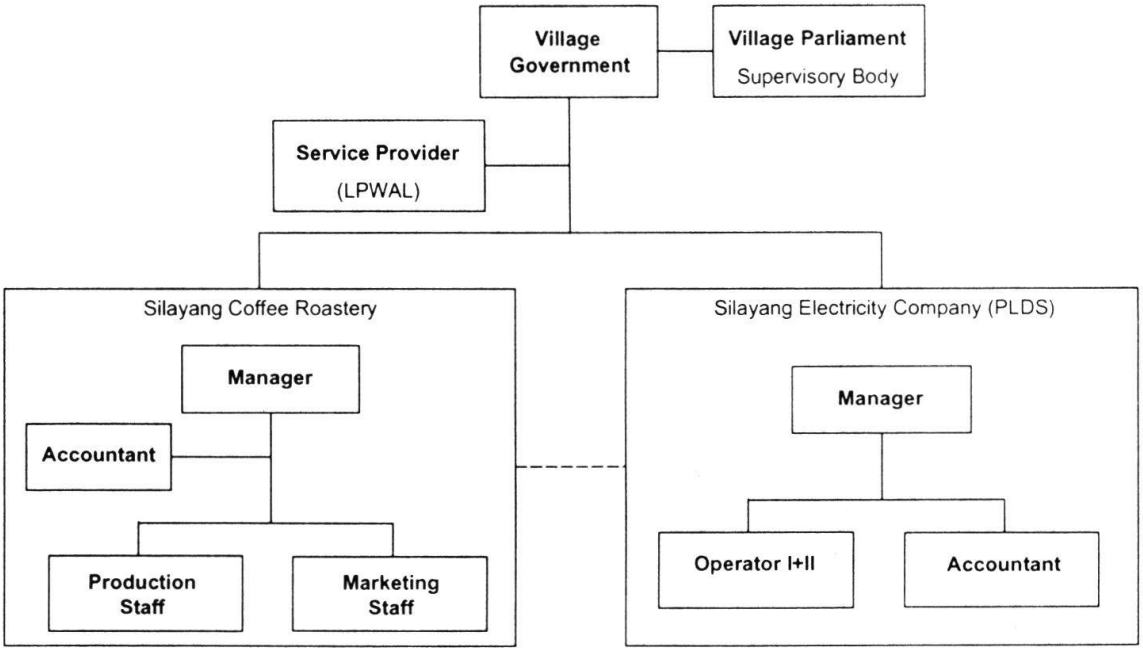

Figure 8: The Structure of the Silayang Village-owned Enterprises[26]

The main reason for that delay was that the incentives offered were not attractive enough to encourage LPWAL to take entrepreneurial risks. The

25 The factory building to be designed should also allow end-uses other than coffee roasting, e.g. the use of sewing machines. However, during a group discussion with women it was found that the place near the mini hydro was too deserted and they preferred a place in the center of the village, which is by definition more lively.

26 Source: MEIER, 2001.

original idea was to offer result-oriented bonus payments to LPWAL to guarantee that the NGO would recover its operational costs from its customer, the village-owned coffee roastery. The bonus system consisted of four milestones:

1. Funding of coffee roastery is approved and agreement signed, regardless of the funding source. Incentive if achieved: Rp. 3'000'000. (ca. US$ 350)
2. Coffee roastery is commissioned using electricity generated by the existing mini hydro plant. Incentive if achieved: Rp. 4'000'000. (ca. US$ 470)
3. Coffee sales volume according to sales forecast in business plan is achieved at the end of the first year after commissioning the roastery. Incentive if achieved: Rp. 3'000'000.
4. The Silayang coffee roastery covers at least the operational costs of LPWAL out of revenues from coffee sales at the end of the first year after commissioning the roastery. Incentive if achieved: Rp. 3'000'000.

End of June 2000, I learnt that LPWAL agreed on the milestone concept but requested a written agreement clarifying the role of the different stakeholders as well as a cash advance to be able to finance further data collection and a search for possible funding agencies. I promised to push forward for such an agreement and transferred Rp. 2'000'000 of my own money to LPWAL's Bank account as a cash advance—two weeks later the first draft of a business plan was submitted.

The experience described above indicates that a pure market-oriented approach to rural business development is not realistic. There are plenty of other (less risky) opportunities where Indonesian organizations can generate income. To make rural business development one of these opportunities, risk-reducing incentives to BDS-organizations were incorporated into the SIAM-approach. A result-oriented milestone concept may be considered part of such incentives, however risks remain unchanged. Non result-oriented, and thus risk-reducing, support is particularly important during the planning and start-up phase of new enterprises. The duration needed for such support measures may be somewhere between six and eighteen months, depending on the type of business and human resources available.

8.1 Services Provided by LPWAL

LPWAL will provide or coordinate the business development and repair services required by both village-owned enterprises as it is stressed in the SIAM approach. To guarantee a close relationship with the village, LPWAL will send one of its staff to Silayang to permanently live there for at least one year. The role of this person will be to train the staff of the Silayang coffee

roastery in all aspects of coffee processing (quality control of raw material and end products, roasting process, grinding, and packing) and management (accounting, marketing). The person will also organize training for farmers in improving the yield of their coffee trees as well as the quality of the beans. In case of technical problems the person will organize the required repair services (including the mini hydro plant).

LPWAL had to promise a good salary for its staff (a young economist) to make him willing to go and stay in Silayang for one year. The monthly salary paid will be Rp. 1 million (ca. US$ 120), which is more than three times the regional minimum wage in West Sumatra and around 40% above a starting salary for a junior economist in Indonesia. To reduce the risks of LPWAL, GTZ-MHP agreed to cover the salary costs during the first half year of operation. In return LPWAL has agreed to submit regular written reports about the progress made in Silayang. After this time LPWAL needs to cover the salary costs from its 15% share of gross profits.

8.2 Required Investment

Existing small coffee roasteries in West Sumatra often use simple steel drums rotating over open fire spaces. I opposed such kind of technology because the main objective of the business development experiment was to use electricity generated from a mini hydro plant. There are roasters designed with electric resistance heaters but these are either small household appliances or industrial roasters with an electric power demand that surpasses the available power from the Silayang mini hydro plant. The cost of industrial roasters from international companies were generally quite expensive ranging from around US$ 9'000 to US$ 40'000 for a 30 kg batch roaster. Referring to my professional background in mechanical engineering, I therefore designed an electric coffee roaster by myself to be produced in Indonesia. The main characteristics of a coffee roaster were derived from the literature.[27] The most important factors in the roasting process are time, temperature and the possiblitiy to take a sample during roasting. The production costs were set at a maximum of Rp. 15 million (ca. US$ 1'800). Additional Rp. 5 million (ca. US$ 600) were reserved for equipment tests and shipping costs to Silayang. All these factors were considered in the design and resulted in a coffee roaster with an average production capacity of around 30 kg per hour or 87 tons per year (assuming a production time of 8 hours per

27 CLARKE, 1987; SCHENKER, 2000.

day). The roaster has been produced in a workshop in Bandung, experienced in the field of food processing. Apart from the roaster the following items had to be purchased:

Coffee grinder	Rp. 25 million (ca. US$ 2'900)
Scales and packing machine	Rp. 1.5 million (ca US$ 180)
Land purchase	Rp. 15 million (ca. US$ 1'800)
Materials for roastery building	Rp. 5 million (ca. US$ 600).
Working capital	Rp. 15 million (ca. US$ 1'800).

The investment totals Rp. 76.5 million (ca. US$ 9'000) excluding inputs provided by myself and GTZ. The investment required for the land purchase is provided by the village. Thus, the roastery requires external financing of Rp. 61.5 million (ca. US$ 7'200).

8.3 Market and Marketing Strategy

The villagers of Silayang identified three different kinds of market areas which should be served with different priorities. The first priority area will be the local market. The second priority area includes the larger markets in Rao and Panti located at the trans Sumatra highway; and the third priority area includes the urban centers of West Sumatra and Riau (e.g. Bukittinggi, Padang, Pekabaru). Based on a market survey, conducted by villagers, a sales forecast was compiled (see Table 4). The projected market growth is based on the assumption that the Silayang coffee factory would quickly gain a large

Table 4: Sales Forecast of the Silayang Coffee Factory in Kilogram[28]

	2001	*2002*	*2003*	*2004*	*2005*
First priority area	6'000	8'000	10'000	11'000	11'000
Second priority area	2'000	4'500	6'000	8'000	9'000
Third priority area	0	1'500	4'000	5'500	7'000
Total	8'000	14'000	20'000	24'500	27'000

28 Source: Projections based on villagers own market survey. The years mentioned in the table refer to full years of operation.

Table 5: Projected Staff Growth[29]

	Number of people employed					*Salaries (Rp./day)*	*Workload days/week*
	2001	*2002*	*2003*	*2004*	*2005*		
Manager	1	1	1	1	1	20'000	2
Accountant	1	1	1	1	1	15'000	2
Operators	2	4	6	7	8	15'000	3
Marketing staff	1	2	2	3	3	15'000	3
Total staff	5	8	10	12	13		

market share in the first priority area due to cheaper products (less transportation costs) and better product quality (100% pure ground coffee) than its competitors. The coffee sales in the second and third priority areas are purely based on estimations by local traders who have already established marketing relationships in these areas.

8.4 Manpower Planning

The annual production growth required to match the sales forecast makes it necessary to employ annually more people. As shown in Table 5, the Silayang coffee factory will start operations with five employees. By 2005 this number is expected to grow to thirteen. It would be possible to match the sales forecast with less manpower by increasing the workload per employee. However, the villagers wished that the workload of employees would not exceed three days per week, allowing them to continue working in agriculture. The salaries paid are above the local average salary of a wage laborer of Rp. 10'000 per day.

8.5 Financial Plan

Income statement

The projected net profits for the five-year planning period range from Rp. 28 million (ca. US$ 3'320) for the first year of operation to Rp. 133 million (ca. US$ 15'760) by the end of year five. The growth in profits is attributed to the growth of revenues from coffee sales in the three market areas.

29 1 US$ = ca. Rp. 8'500.

Cash Budgets

Cash budgets have been prepared indicating that initial working capital of Rp. 15 million (ca. US$ 1'750) will be sufficient if the first cash will be received in month three after production start. In case of delays the Silayang coffee roastery would need to borrow additional funds. Increasing payments will be made into the village development fund ranging from Rp. 14 million (ca. US$ 1'650) at the end of the second year of operation to Rp. 33 million (ca. US$ 3'900) at the end of the projection period.

Balance sheet

The Silayang coffee factory will have paid off its initial debts of Rp. 61.5 million (ca. US$ 7'200) during the fourth year of operation. Despite this quick debt retirement, the construction of a new roastery building and payments into the village development fund, the available cash quickly increases, reaching Rp. 233 million (ca. US$ 27'400) at the end of year five. A large part of this amount can be used in the long-term to renew the capital assets of the coffee roastery and the mini hydro plant. This money could be invested with low risk on the bond market.

8.6 Possible Benefits for the Village Community

The village of Silayang is the only owner of the Silayang coffee roastery. It is planned to pay 25% of net profits into a village development fund starting at the end of the second year of operation. The other 75% will remain in the coffee roastery, one part of it as working capital and another part as savings planned to be spent for the renewal of equipment both of the coffee roastery and mini hydro plant. Without these retained earnings there would not be the necessary means to renew the mini hydro plant. Thus, the coffee roastery contributes to a sustainable electricity supply in the village. The village leadership agreed that the village development fund should be spent for the benefit of all villagers. In line with Article 107 of law 22/1999 this fund shall be managed through the Village Revenues and Expenditures Budget which is annually stipulated by village head and village parliament. Following are the first ideas presented about on how the village might spend the new resources:

- Expand the capacity of the power plant to electrify all households in the village,
- Subsidize school fees for low-income families,
- Build a junior high school in the village,
- Re-capitalize savings and credit system (existing system is out of operation because credits are not served anymore).

8.7 The Realization of the Coffee Roastery

To be able to start the realization of the Silayang coffee roastery, a financing institution had to be found providing the required funds of Rp. 61.5 million. This proved to be more difficult and time-intensive than anticipated. The unstable political and financial situation in Indonesia during the year 2000 prevented local Banks (Bank Nagari and Bank Rakyat Indonesia) from providing credits. A number of other possible financing institutions were contacted with no success. The situation changed when visiting the Head of the Pasaman Regency (Kabupaten) in West Sumatra[30] during the third visit to Silayang in September 2000. The Regent, now responsible for the economic development of his Regency, kindly promised to provide the required funds. It was agreed that a loan of Rp. 61.5 million would be disbursed at an annual interest rate of 10% and a repayment period of three years. A grace period was granted including the third month after the coffee roastery started operations. Because the Indonesian experience shows that governmental funds are seldom fully repaid, it was agreed that the credit should be handled through Bank Rayat Indonesia located in Lubuk Sikaping.

The realization of the Silayang coffee roastery is still going on and will most likely reveal unforeseen obstacles. Personally, I would be satisfied if the first cup of Silayang coffee could be brewed at the end of 2001.

9. Conclusions

The present paper shows that rural electrification programs, including mini hydro programs, are burdened with a multitude of expected benefits which can hardly be realized. There are general assumptions that electricity may contribute to industrial development, while improving health services, education and the position of women. However, there are commonly no or too few activities conducted in such fields, which is why the effects fail to materialize. In the case of mini hydro programs, experts have planned and installed technically sophisticated equipment in very remote rural areas and left the village communities alone with it after the plants were commis-

30 The province of West Sumatra is divided into 8 Regencies (Kabutpaten) and 6 municipalities. These administrative regions have received wide-spread autonomy under the ongoing regional decentralization.

sioned, hoping that they would keep them running. They generally failed to adequately accompany the setting up of management structures and to organize repair services, with the consequence that most plants cannot be reliably and sustainably operated.

Donor agencies should prevent projects becoming burdened with too many objectives and expectations. Villagers greatly appreciate electricity because it improves their quality of life and gives them the feeling that they are participating in a modern way of live hitherto seen as the preserve of urban dwellers. Harnessing waterpower on a small scale is a useful and environmentally friendly way of electrifying villages. However, a mini hydro project should not be justified because of its effects on industrial development, better health, education and improvements of the situation of women as long as these fields are not specifically addressed with appropriate activities. A donor agency conducting mini hydro projects should only mention expectations in fields for which the necessary resources for additional inputs have been made available. Otherwise, mini hydro projects may easily be judged a failure despite a positive assessment by villagers.

The SIAM approach goes beyond addressing just these known shortcomings by integrating mini hydro operation and productive electricity uses. Village communities are no longer left alone but are supplied with various need-oriented services. Initial practical experience of the approach gained during the planning and realization of a coffee roastery indicates that mini hydro operation could indeed contribute to rural development by providing the revenue basis required for sustainable plant operation and village development activities. It has also been shown that market-oriented principles of business development are not restricted to urban areas but can also be applied in even very remote rural areas. This opens up the possibility for similar market-oriented approaches to be applied in almost any part of developing countries. However, insight gained during the experiment suggests that the main obstacles to a broader adoption of the approach are the lack of competent organizations willing to work in rural areas and difficulties in finding funding agencies.

A very interesting result was that regional decentralization can encourage Regencies to act as partners for rural development activities. The Regent of Pasaman was very open concerning our ideas to promote a village-owned coffee roastery in Silayang based on the SIAM approach. The Silayang coffee roastery is seen as a test case. If successful, the Regent would be ready to support the dissemination of a similar approach throughout the Regency. Although it is not yet possible to present operational results from the

Silayang coffee roastery, the fact that the idea gained a Regent's support already marks a success. A profitable coffee roastery would benefit all the people of Silayang. This can only benefit the Regent's reputation, thus improving his chances of being reelected in the next democratic elections. And a successful Regent may encourage others to copy his formula.

Apart form these promising issues, the overall experience gained in this study indicates that there needs to be a discussion of whether the objectives of technical assistance are still realistic or not. The present work pinpoints a gap between the objectives formulated by donor agencies and the results achieved in rural energy development projects. In future, objectives should again become compatible with achievable results. Otherwise, donor agencies run the risk of jeopardizing the credibility of development cooperation.

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