

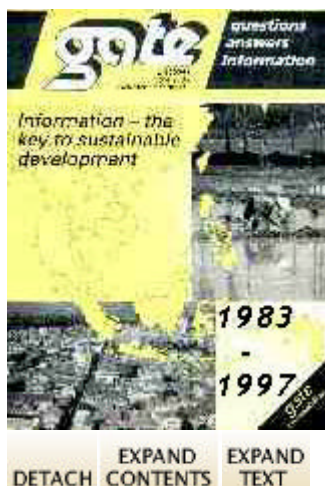
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Report



Lessons from the Thai-German Biogas Programme

## Lessons from the Thai-German Biogas Programme

Advantages **of** the "Biogas" Technology by Ulrich Stöhr-Grabowski

Experiences from biogas technology dissemination programmes have taught us that it is not just a technology for poor people. At present day prices, biogas can only play a limited role **in** substituting for fossil energies. But biogas' future lies **in** environmental protection and its contribution to alleviating the greenhouse effect. A comprehensive dissemination programme can also make biogas an interesting alternative energy. **In** Thailand for example. The author focuses on the advantages **of** biogas for the agricultural sector, based on his experiences as former advisor to the Thai-German Biogas Programme **in** Chiang Mail

Since the first oil crises **in** 1973, efforts have been intensified to develop and disseminate biogas systems **in** developing nations. Notably China, India, Brazil and Nepal started large programmes under energy and health/sanitation aspects, but with dissimilar success. The Brazilian programme **in** the agricultural sector, for example, almost came to a standstill.

**In** discussions on anaerobic fermentation programmes nowadays, the energy and the health/sanitation aspects are joined by a third factor: the influence anaerobic fermentation systems have on the so-called greenhouse effect, mainly the uncontrolled release **of** methane (cf. Jochen Mailaender **in** gate 4/93).

Renewable source **of** energy

At present, most anaerobic fermentation systems are used **in** the agricultural sector and **in** connection with sewage treatment plants. The technology is being increasingly applied **in** numerous agro-industries like breweries, starch factories and canneries.

What are the "pro's" **of** the anaerobic fermentation technology ?

Biogas (60 % methane) provides a renewable source **of** energy for cooking, water-heating, operating piglet heaters and - **in** larger systems electricity generation and process heating. **In** developing nations it contributes to the substitution **of** firewood, charcoal, and bottled gas (LPG).

**In** Thailand, the construction **of** digesters with a total volume **of** 100,000 m<sup>3</sup> - for small farms as well as medium and large-size pig farms **in** selected locations - a government authorities decision is

expected during this year-would provide at least 17 million m<sup>3</sup> **of** biogas i.e. an energy potential able to replace 22 million kWh/year **of** electricity or 7.5 million kg **of** bottled gas.

From the aspect **of** savings **in** firewood consumption, the biogas technology is by no means an efficient way to reduce the depletion **of** forests. Wood-saving cooking stoves and reforestation programmes are much more effective and have a more favourable cost-benefit ratio.

Nevertheless, biogas technology still has manifold advantages, and does contribute towards saving firewood to a certain extent. Under the biogas programme **in** Thailand, the planned construction **of** 2,000 household-size systems within the 100,000 m<sup>2</sup> programme can result **in** annual savings **of** about 9,000 tons **of** firewood. **In** Nepal, the biogas dissemination programme (30,000 household-size systems by 1997) anticipates savings **of** up to 120,000 tons per year once all systems have been constructed. **In** fact, the Nepalese programme concentrates very much on energy aspects.

Also, from the users perspective, the technology is financially viable and acceptable to the individual mainly because **of** the energy the systems produce:

#### Users perspective

Small farms appreciate having an autonomous source **of** energy on the farm-yard, resulting **in** savings **of** LPG, kerosene, charcoal, and firewood. A survey **in** Thailand indicated that the amortization period is below 6 years for 49 % **of** the pilot biogas plants - mainly generated by the substitution **of** conventional energy sources.

For 51 %, the pay-back period exceeds six years and **in** some cases even the assumed technical life span **of** the systems. 54 % **of** the biogas systems observed record an Internal Rate **of** Return (IRR) **of** more than 8% which is the interest rate on savings accounts at commercial banks **in** Thailand. And: the profitability **of** biogas plants will improve considerably if the full amount **of** biogas produced per day is put to maximum **use**.

On the other hand, for households saving mainly "low-price" or "no-price" firewood and charcoal, the financial indicators are quite unfavourable. These firewood and charcoal consuming farmers **in** particular, however, are the ones who should, for macro-economic reasons, be given the possibility to shift to other energy sources

#### Lower work-load

For women, biogas results **in** a lower work-load compared to the pre-biogas situation and reduces the efforts necessary for firewood and charcoal collection. For small farms, the working time required to operate the overall biogas system is a very important factor for the acceptance **of** the biogas plant. Women are frequently involved both **in** filling the plant and utilizing the gas. They have to **use** their daily working time budget economically, so their opinion can be decisive for the sustained **use of** the system.

**In** a survey **of** the Thai-German Biogas Programme among small farms, 64 % **of** the respondents stated that the biogas system causes less work **in** relation to the "pre-biogas" situation, mainly due to the easier access to energy. 26 % **of** the responses suggest an equal workload, and 10 % state that it is higher.

#### Waste water treatment

The **organic** loading rates **of** waste water and liquid wastes can be reduced significantly and cost-efficiently through the anaerobic fermentation process. Improved hygienic conditions, cleaner stables, smell reduction and a safer and cleaner cooking process are some **of** the advantages which

attract animal farms **of** all types and sizes to invest **in** biogas technology.

The combined aerobic/anaerobic systems, which are offered **in** Thailand to pig farms with more than 200 animals, can achieve a BOD/COD reduction between 80 % and 90 % for the animal manure discharged into the system. Moreover, the farms can reduce their water consumption by recycling treated waste water. Proper management and regular checks **of** the operational system are required to achieve these results.

Through the process **of** energy recovery when applying the anaerobic fermentation system, the farm is able to recover up to 40% **of** its annual financial burden for the treatment system (incl. capital costs) through biogas generation and utilization. **In** contrast, a purely aerobic process would require a considerable input **of** energy.

#### Reduction **of** methane emissions

Contrary to the potential **of** the anaerobic fermentation technology, pig farms **in** Thailand presently release methane **in** an uncontrolled manner from open ponds used to store pig manure and located behind large farms, which contribute significantly to the so-called " greenhouse effect ". The biogas programme intends to halt the methane release by offering technical solutions for the controlled utilization **of** the gas and by advising the farmers to **use** the biogas to the maximum amount possible. Otherwise, the methane has to be burnt off.

For the 100,000 m: programme **in** Thailand, an annual reduction **of** methane emissions **of** about 7,000 tons would be possible, compared with the official 480,000 tons the country releases per annum through animal husbandry. The figure is low but a move into the right direction.

Unlike the burning **of** fossil fuels, the process **of** biogas energy production does not increase the concentration **of** CO<sub>2</sub> **in** the atmosphere, because the CO<sub>2</sub> produced during methane-fermentation has already been taken out **of** the atmosphere by plants, and has been changed into biomass through the process **of** photosynthesis.

#### Fertilizer supply

Effluent from the biogas digester (fermented slurry) is a valuable source **of organic** fertilizer and supports the recycling **of** biomass on the farm. The main nutrients (N, P, K) **of** the animal manure are preserved. Nitrate pollution **of** the groundwater can be lowered if the system is properly operated.

**In** places where regular **organic** fertilizing is uncommon, the agricultural extension services provided **in** connection with the operation **of** the anaerobic fermentation system can be an incentive for the **use of organic** matter on fields and **in** vegetable and fruit gardens.

Although the fertilizing value **of** the fermented slurry is not (or only under certain conditions) higher than composted unfermented manure, the harmful effects **of** untreated pig manure on plants cannot be observed after the manure has undergone anaerobic treatment.

Altogether, biogas systems contribute to improving living conditions **In** the agricultural sector, generally upgrading the farming systems and the animal keeping practices, sensitising the population to the needs **of** ecology and last not least, upgrading and training craftsmen, small construction companies, agricultural extension workers and farmers **in rural** areas.

#### Employment opportunities

The technology has the advantage **of** providing employment for craftsmen as well as small and medium-sized enterprises **in rural** areas. The 100,000 m<sup>3</sup> construction programme for Thailand can

create about 660 person-years **of** employment opportunities for craftsmen and technicians within a 6 year period (1994-2000). **In** addition, about 1,100 person-years for helpers/unskilled labour can be provided **in** the same period.

#### Technological capacity building

The technology can first be introduced **in** the form **of** small agricultural systems as a proven technology. Subsequently, solutions can gradually be developed which are applicable for larger farms, for waste control **in** agro-industries, and for domestic waste water treatment with more sophisticated input requirements.

The technology has quite a high potential for a direct South-South transfer **of** technology know-how. As a considerable part **of** research & development on biogas technology was carried out **in** countries such as China and India, consultancy services and improvements appropriate to the specific conditions **in** the developing world can be implemented directly without any inter mediation **of** industrialized countries.

This contributes to national capacity building **in** the field **of** technology development and management skills. The Centre for Agricultural Mechanization and Technology (CAMARTEC) **in** Tanzania, for example, is now offering international biogas training courses for participants from Africa, Asia, and even South and Central American countries.

#### Savings **in** foreign exchange

The facts mentioned above, joined with the fact that the technology mainly uses locally available construction material, are favourable towards savings **in** foreign exchange. The provision **of** an autonomous and renewable source **of** energy and the generation **of organic** fertilizer also contribute to import savings.

The most serious objection against the anaerobic fermentation technology addresses the financial feasibility **of** the investment. For many farms, however, the financial aspects **of** the technology are not the decisive point for or against investing **in** a biogas system.

As shown **in** an economic survey conducted by the Thai-German Biogas Programme, many non-quantifiable motives determine the acceptance **of** the technology. Among these, public awareness and the enforcement **of** environmental laws are forcing an increasing number **of** animal farms and agro-industries to integrate waste water treatment technologies into their operations.

#### Cost-benefit analysis inadequate

The inadequacy **of** the traditional cost-benefit analysis (CBA), often places the biogas technology **in** a negative light from the economic feasibility viewpoint. The traditional CBA mainly gives an insufficient valuation **of** depletable energy resources like fossil fuels.

It seems necessary to assess the advantages and disadvantages **of** the anaerobic fermentation technology **in** a more comprehensive approach which should include all impacts **in** the field **of** energy, environment, agriculture, employment, social welfare and income distribution, acquisition **of** technological competence as well as sustainable regional and national development.

When planning a dissemination programme for anaerobic fermentation systems, a careful assessment has to be made **of** what political support can be secured for such a programme on all decision-making levels and a motivated and efficient dissemination agency has to be identified.

Pradet farm: Energy, Fertilizer, Recycled Waste Water

The 50 m<sup>3</sup> biogas plant at the Pradet pig farm and rice mill **in** Lamphun Province is a rather good, but still rare example **of** a biogas plant integrated into the agricultural unit. The three advantages **of** biogas technology, as it is actually applied at Pradet farm, are:

- A considerable amount **of** the produced biogas (more than 20 m<sup>3</sup> per day) is consumed by the dual fuel engine operating the rice mill. The biogas substitutes part **of** the diesel fuel. The remaining biogas is used for two piglet heaters, one gas stove for the farm employees and the biogas lamp at the entrance gate to the farm.
- The effluent from the biogas plant is dried by means **of** sand-bed filters.

The dried material is sold as **organic** fertilizer for 3 Baht per 15 kg. The fertilizer is also used for eggplant production by the farm employees.

- The water output from the sand bed filter is recycled and used to clean the pig pen, and thus - to a large degree - re-enters the biogas plant with the manure.

The Internal Rate **of** Return **of** about 24 % together with the amortization period **of** 3.7 years make the biogas system a profitable operation, even without any enforcement **of** environmental laws. The fact that the diesel engine was already available **in** the rice mill's compound and was easy to convert to biogas utilization was a mayor advantage for the farm.

Introducing AT-FORUM NGO-GTZ: AT-Association, German Agro Action, German Development Service

**In** gate 2/94 we began to introduce the members **of** the AT-Forum NGO-GTZ. The seventeen member organizations differ greatly with regard to size, organizational structure, sources **of** finance and the extent to which they specialize **in** Appropriate Technology (AT). We have asked three other members **of** the Forum to profile their involvement and activities **in** the field **of** Appropriate Technology.

German Agro Action/Deutsche Welthungerhilfe

German Agro Action (GAA), founded **in** 1962, is a non-governmental organisation for development cooperation and emergency relief, is non-profit-making and not tied to any political party or religion. **In** its mandate and articles **of** association the GAA is dedicated to promoting help towards self-help and achieving self-reliant food security **in** developing countries. A further field **of** activity is education on development policy **in** the Federal Republic **of** Germany. GAA is seated **in** Bonn and finances its operations from private donations and public subsidies. It is obliged to regularly publish facts and figures on its income and expenditures.

GAAs activities focus on development cooperation projects (together with emergency relief projects and a promotion programme for children and young people). **In** 1993 allocations amounting to DM 40 million were granted for the support **of** 151 new projects **of** partner organisations. 30 % **of** GAA funding went to projects **in** Latin America and Asia respectively and 40 % were used **in** Africa. Projects cover the sectors agriculture, livestock farming and forestry (60 % **of** project funding) followed by water supply (15 %) and institution building (10 %).

About 75 % **of** GAA-assisted projects involve funding **of** between DM 50,000 and DM 250,000. **In** individual cases DM I million or more can be allocated to very complex projects designed on a long-term basis. Activities **in** agriculture, livestock farming and forestry chiefly address smallholder subsistence farming **in** marginalized locations and also integrated and regional development projects, village development programmes, assistance to women, self-help programmes and self-help groups,

environmental protection and natural resource conservation measures, erosion control, the introduction **of** locally appropriate land-**use** systems, loan funds for village craft enterprises, and agricultural credit funds on a monetary and "**in-kind**" basis.

**In** its cooperation with partners, GAA sees itself as an advisory financing institution. **In** order to enter into a competent dialogue with its partner organisations, all projects put forward for assistance are first screened according to the criteria below, before any financial obligations are entered into:

- Does the partner organisation possess the specialized technical, organizational and administrative capacities to guarantee self-responsible and target group oriented planning **of** project activities?
- Do the target groups fully participate **in** identifying planning, implementation and management problems? Only active participation assures that the projects are accepted by target groups and mobilizes their willingness and self-help potential.
- Is the project technically feasible? Technical measures must be designed to be fully mastered by the local partners and target groups. Technical innovations must be based on existing technologies and local know-how, and match the given socio-cultural conditions.
- Are production-oriented projects sufficiently geared to economic viability? The prime aim here is to maintain subsistence farms, make them more efficient and thereby guarantee the target group's capability to survive.
- Does project implementation planning include environmental protection and resource conservation measures? Every project implies additional tapping **of** natural resources. This automatically increases the burden on the environment, which **must** be kept to a minimum.
- Are project measures socio-economically compatible? Activities should not generate any negative economic, social or ecological impacts for the target groups or other persons **in** a similar situation **in** the direct or indirect catchment area.

GAA sees every project as being an intervention into a societal development process. The aim **of** the screening criteria is to measure the appropriateness **of** project measures **in** their technical, economic, ecological, socio-political and socio-cultural dimensions which always interact. **In** GAA project assistance, therefore, AT is involved on a wide basis and not just reduced to a technico - empiric al orientation. It is clear to all concerned that each given project environment is always very different, and each component activity must be weighted accordingly. Overall, however, attempts are made to balance out all dimensions and integrate them into harmonised project activities.

Institution and capacity building will be given greater emphasis **in** future **in** the scope **of** the strategy for GAA project assistance. Member ship **in** the AT forum NGO-GTZ is a major step towards intensifying support and advisory services to partner organisations. GAA expects to receive new impulses and generate a wider discussion basis at its head office through its working contacts with members **of** the forum, and, above all, hopes that the establishment and support **of** a network **of** local specialised advisory services will intensify the opportunities for cooperation and the exchange **of** experience between partner organizations **in** countries **of** the South.

Peter Kowoll

German Development Service (DED)

The German Development Service (DED), founded **in** 1963, supports programmes **of** partner institutions **in** 42 countries **of** Africa, Asia and Latin America aiming at improving the living conditions **of** the population. Over the past 30 years, some 10,000 qualified and dedicated women

and men have assisted the work **of** governmental as well as nongovernmental institutions **in** the fields **of** health, agriculture, vocational training, education, small scale business promoting etc.

Focus lies on fighting poverty, promoting self-help activities and women **in** development. DED is a private organization, 100% funded by the government. (Funding **in** 1994: DM 125 Mio.) Currently there are about 1,000 development workers **in** the field.

Background: It would have been very atypical if DED volunteers had not taken their euphoric attitude on appropriate technology with them to their host countries **in** the 70ies and transferred this to their own work. Focus was on technologically "cunning" solutions. AT seemed to be the long awaited link between traditional and modern technology. The people whose problems were to be solved by technical assistance were seldom involved **in** the development or decision-making processes. Only very few products or procedures proved to be viable over a longer term. No-one knows exactly how many prototypes were developed.

But the real task for which partners had requested experts seemed to be neglected **in** the wake **of** this euphoria. To counter this situation special courses were incorporated **in** the DED volunteers briefing, **in** which a sound AT approach was taught and set **in** comparison with more or less DIY solutions for solar and wind energy and biogas projects **in** the host countries.

Parallel to this, GATE and other European AT organisations further developed their programmes and concentrated on disseminating them, although there was seldom coordination on the given narrow goals. Cooperation between DED and GATE dwindled down to unimportance, because the problems experienced by the partners and the questions asked by development volunteers could be rarely or only inadequately answered.

Experience and findings: The activities and measures **of** the first AT generation were assessed positively at the time, but when looking back often proved to be isolated solutions to problems which remained insignificant **in** the overall context. They had either to be adapted to the actual needs or stopped all together. It was also realised that AT dissemination did not take place via institutes, publications or similar media, but via the volunteers who had made their own, hands-on experience: The top-bar beehive (frameless bee hives) developed **in** Kenya gradually disseminated through Tanzania,

Botswana and Zambia. Written encouragement from the DED Head Office **in** Berlin or talks with the volunteers on site which just limited to diagrams and descriptions soon ran aground and were seldom applied **in** the host countries. A major precondition for acceptance was that the given problem situation was actually experienced **in** the countries. Even technologies which had proven to be successful elsewhere, for example, the maize mill **in** Botswana, failed to be accepted **in** West Africa despite, all efforts to this end.

Positive AT examples all have the following common features:

- The demand for them was formulated together with the target group.
- The economic, social and political framework conditions were conducive for the project.
- Additional work harmonized with the time-budget **of** the users.
- The economic benefit **of** the measures compensated for the higher workload involved.
- The actual needs demanded inter-disciplinary action.
- A participatory procedure assured the sustainability **of** the results.

Vocational training, still a major area **of** DED work today, produced many examples **of** appropriate training courses which were not sufficiently disseminated. Income-generating activities require different training contents to those often provided **in** regular training courses. Curricula and teaching aids must be geared to the products to be produced and the services to be provided. **In** particular supplying the partner with teaching materials which match its situation and the regional circumstances has only been carried out to a slight degree.

**In** agriculture the chief inputs **of** AT are lacking to date. Post harvest technology **in** particular is becoming very important **in** food supply for the local population and **in** creating income, especially for women. Appropriate technology is lacking, for instance, for the small farmers to independently process manioc, cashew nuts, corn oil, etc. When disseminating individual measures which are usually interventions into complex relationships, a high degree **of** social competence is necessary.

Procedures and technologies for resource conservation and erosion control were drawn up together with the resource users and further developed **in** line with the experience and new knowledge gained by the participating population. Alternative technology is therefore based on participation, is variable and is **in** no way a static technology. Its design and sustainability are determined by the **use** actually made **of** it.

**In** construction and sanitation, drinking water supply, well headings, well building and the construction and maintenance **of** hospitals and health stations are given high priority. Road and bridge building always require new, locally-adapted solutions. The **use of** local materials based on existing craft know-how always requires adaptation to and development **of** local solutions.

The promotion **of** small scale industries is facing not only a lack **of** non-technical preconditions, but also shortcomings **in** the further development **of** products and procedures. Traditional products and the production procedures no longer guarantee a secure income. Imports, usually manufactured on an industrial scale, have a convincing design and relatively low prices thanks to series production. Men and women craftspersons **in** Third World countries who have received both traditional and modern training are usually only skilled **in** manual production. Semi-industrial production which could deliver goods **of** comparable quality to those imported and even at lower cost is still very alien. For production **of** this type to grow up, however, production inputs must be developed which are based on local skills and a selective degree **of** mechanisation introduced that can lower production costs down to a competitive level. The development **of** products, procedures and production inputs is the basis for successful promotion **of** small-scale industries and must be part **of** AT **in** the future.

The realization **of** what is actually feasible, the declining capacity **of** German experts to transfer simple technical skills, coupled with technological pessimism derived from our perceived world and all its environmental problems, should not lead to our declining to transfer productive technologies for our partners. The assigned experts must have a greater capacity to think **in** complex correlations, and to act on a participative basis.

Even though we know that natural resources are finite, we must nevertheless commit ourselves opening up access to ecologically acceptable employment and income for people **in** the Third World.

"Develop and forget" could describe the situation **in** past years. Generations **of** specialists have gathered knowledge. But seldom have their successors or local partners been able to exploit these experiences because the documentation available was inadequate.

A major component **in** order to maintain and further disseminate proven ideas is an understandable, technically clear and low-cost system **of** documentation. Positive examples to be followed must be available for outsiders as concrete decision-making aids. It should not be necessary to continuously discover the wheel. Systematic documentation **of** experiences made by the DED and other



organizations is urgently required.

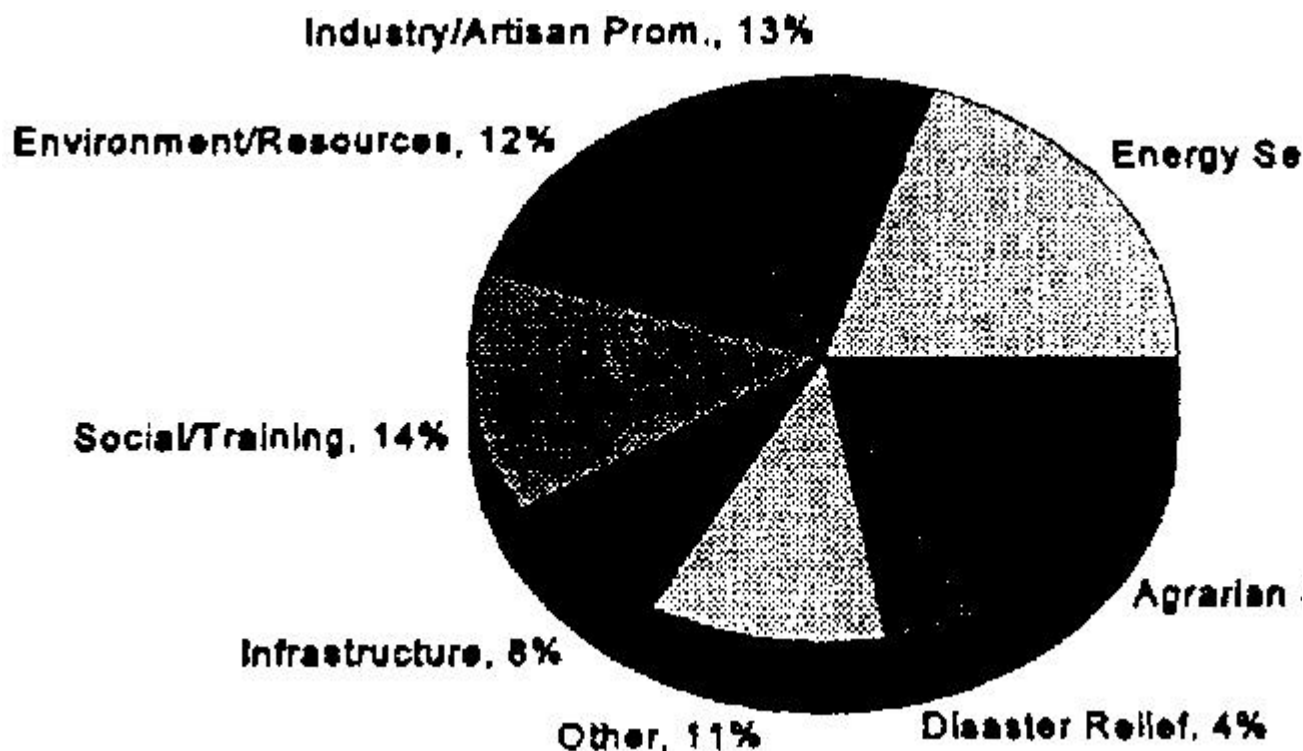
The establishment **of** the AT-Forum NGO/GTZ, an association **of** Germany's well known NGOs, has awakened new hopes at the DED to support GATE **in** its path towards establishing a reality- and needs oriented service centre for partners **in** the Third World.

The DED, with its strong outside structures and grassroots work can recognise the needs **of** the partners **in** the early stage, and help **in** finding a solution via discussions within AT-Forum. **In** this way GATE's technical competence can be expanded and put on a more varied and real-time basis to be used by its partners.

Wolfgang Schunke

AT-Association

The AT-Association for the promotion **of** socially and environmentally appropriate technology was founded **in** February 1988 by a group **of** people with long-standing experience **in** development cooperation wishing to look for new ways **in** this field. The starting point for our work is the appropriate technology approach **in** its broadest, interdisciplinary sense.



AT Association: Core Work Fields **of** Members

Presently the Association consists **of** about 100 members: small consulting firms, individual freelance consultants, members and associates **of** research institutions and groups and organizations committed to developing and disseminating appropriate technology **in** countries **of** the South and the North.

What we strive for: The Association's aim is to call attention to an integrated concept **of** "appropriate technology" and generate the recognition this concept deserves: short term economic rationality and technical efficiency have not stood the test as exclusive criteria for choosing and developing technology. AT links specialist technical knowledge with ecological, socio-economic and socio-cultural understanding and competence.

With due consideration for local living and working conditions, people's traditional knowledge and environmental impacts **of** projects, the term "appropriate" implies a new quality that extends far beyond purely technical or economic criteria.

What we do: The AT-Association gives appropriate technology specialists access to networking, so as to facilitate the exchange **of** information and experience. Interdisciplinary working groups are developing new approaches and concepts for special problems **in** international cooperation. Three working groups are operating at the present time. The first one is dealing with appropriate technology **in** energy supply, the second one is specialized on the worldwide growing problems **of** refugees and disaster relief, the third one is working on concepts for socially appropriate project management.

The outputs by our working groups form the basis for work by our own members, and as the AT-Association is **in** permanent exchange with development institutions we are able to present these concepts to them and **in** this way to propagate integrated AT-concepts to the authorities.

Where the money comes from: The AT-Association is a registered non-profit making organization. **In** spite **of** growing membership numbers the AT-Association is not yet **in** a position to fully cover its financing from its own income. So far, the proceeds from membership contributions cover only some 40 % **of** the costs entailed **in** maintaining the general structure **of** the association. Only after achieving a membership **of** c. 200 will the Association be financed for the most part from its membership fees.

Until then, the AT Association is compelled to generate additional income by offering its professional services to third parties. Its broad-based membership is **of** great benefit **in** this context: on the one hand the Association can offer a broad spectrum **of** professional services while on the other hand it can deploy numerous members when dealing with outside inquiries and commissions. One way **in** which the Association is improving its general situation is **in** managing a database on AT-experts developed for GTZ/ISAT. But **in** the end the Association can only keep on working thanks to the voluntary commitments **of** its members.



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