Towards a Technology Strategy for Sustainable Livelihoods

Introduction

There are 1.3 billion people living in extreme poverty and suffering from major shortcomings in terms of food, water, health services, housing, energy and jobs. With so many basic needs unsatisfied, there must be a way to translate human creativity (Research and Development) into tools (Science and Technology) for the betterment of human living conditions. In addition, we are witnessing the finite nature of natural resources and the beginnings of large-scale negative consequences of not designing technologies with the environment: We have seen as well the negative consequences of not designing the process within the context of the human user's skills, interests, priorities, cultural orientation and resources. This paper lays the groundwork for consideration of these issues and attempts to set forth some of the strategies for adaptation of technology in the context of the Sustainable livelihoods approach.

This chapter advocates a systems approach to technology development which, while focused on the grass roots level, incorporates all stakeholders in the development strategy from the local to international level. For our purposes, 'technology' comprises know-how and skills, goods and services, equipment (hardware) to organisational and managerial procedures, institutions and (social) support structures. To be truly *appropriate,* a technology must be compatible with available natural, human and financial resources and correspond to the cultural practices of users.

The objective of a technology strategy for sustainable livelihoods must be the development and adoption of technologies which:

1. Improve the productivity of a communities assets;
2. Enhance capabilities and provide for new livelihood opportunities for the poor;
3. Are sustainable in an environmental and socio-economic sense i.e.: technology that promotes equality in society.
4. Empower communities especially vulnerable groups within this sector.
5. Link communities in similar circumstances and relevant stakeholders through appropriate networks.

The SL approach requires technology development to emphasize the importance of establishing links between indigenous knowledge and outside scientific knowledge. The reason for this is twofold: firstly to ensure that local problem identification and insights remain the starting point for inquiry; and secondly to accelerate innovation by systematic and focused efforts that build on indigenous scientific methods as well as examples from outside the community or country. This process involves building networks using to the fullest extent possible modern information communication technologies (ICT's), to facilitate the exchange of knowledge and best practices.

With its focus on production and growth, the SL approach looks for models beyond the public sector. The private and public sector share organizational traits

and both have in the past relied heavily on command structures and bureaucratic models. Both are changing today to become more flexible and innovative but the private sector is clearly leading this transformation in response to the pressures of global competition, hence the stress on modern business concepts in this TSSL chapter. The SL approach to technology is not much different from the logic applied to any new business venture (Table 1).

Table 1 : Business ventures and sustainable livelihood strategies

Business Investment	Sustainable Livelihoods
Strengths, Weaknesses, Opportunities and Threats (SWOT)	Participatory assessment of adaptive strategies, entitlements, assets and information
Economic and Political Risk analysis	Analysis of the macro, micro and cross sectoral policies impacting on the livelihoods system
Proprietary Technology and Information acquired through licensing or in-house development	Determination of the possible contribution from modern science and technology to complement indigenous knowledge
Assessment of financing schemes, educational system	Identification of social and economic investment mechanisms

While innovation is the key to success in the long term, it must have a strong local dimension since conditions and aspirations vary considerably from place to place. To be sure, innovation already does take place at the community level in response to changing circumstances. However, it is generally very incremental and slow. A main reason for this is that it is spontaneous rather than anticipatory. Systematic and targeted efforts in the form of Research and Development (R&D) are generally only pursued at a higher level of organization than the community.

The purpose of this paper is to contribute to the definition of the Technology Strategy for Sustainable Livelihoods (TSSL). To do this, the chapter will (1) look at what is meant by a systems approach to TSSL and (2) describe the 3 tier framework (national, meso- and local levels) in which the TSSL takes place and outline recommended action at each of these levels. The chapter will also (3) outline action which can be taken to improve linkages between the stakeholders who will be involved in the TSSL discuss methods of ensuring community participation in technology development. This is followed by (4) a discussion of action that can be taken to ensure community participation in the TSSL and (5) a section highlighting the importance of technology on organisational systems i.e. marketing and distribution). Finally, the chapter will (6) propose practical action and entry points for the development of a technology strategy for SL. Throughout this chapter, the discussion illustrated by a series of concrete cases studies from the Asia-Pacific, Africa and Latin America.

1. A Systems Approach to TSSL

This section examines the implications of a systems approach for TSSL. Science and Technology has traditionally been characterized by a sectoralised linear approach. In comparison, the systems approach reflects the fact that the TSSL is holistic with its multi sectoral and multi disciplinary process. Science and

Technology can only fully utilize the assets of communities when it undertakes such a challenge within a systems' framework.

Table 3: Systems approach to technologies

Key characteristics
Portfolio of Technologies
Technologies change over time to meet new conditions
Technologies suitable to local conditions
Technology mix aims to meliorate all components in the system
Technologies aim for improved productivity of materials by using waste by-products and energy, elimination, eliminating waste were possible
Multi-disciplinary research

First and foremost is that one technology can never offer the solution to a complex challenge such as poverty eradication and sustainable livelihoods. A portfolio of interconnected technological options will be needed.

Second, that the solutions useful and valid today, are not the same solutions tomorrow. The technologies which are valid in a first phase of development, may be transitory and be phased out in a second stage. Technologies are not static, but evolve over time as the circumstances change and the needs evolve. As sub-systems such as environment, culture, and dietary traditions change, so will the mix of technologies change.

Third, a systems-based technology strategy will recognize that there are no unique solutions and that there is a need to call upon science and technology which is adapted to the specific dynamics of the system and community where SL is implemented.

Fourth, within the system, the aim is to meliorate all the assets in the system, and not just one component to the detriment of the whole. The SL strategy is a comprehensive program whereby the objective is not to improve income levels, but also non-quantifiable parameters such as human well-being, resilience to stress and capacity to overcome calamities.

Reforestation and Drinking Water

The Environmental Research Center Las Gaviotas initiated an 11,000 HA reforestation program in Vichada, on the Eastern side of Colombia. As the reforestation advanced, the acidity of the soil improved from 4.5 to 5.5 and as a result the soil bacteria became enriched. This led to the generation of drinking water. The water, collected through wind mills and packaged in recyclable PE-bags of 250 milliliter, can now be offered to the people at one quarter of the cost of bottled water brought over land from Bogota. Since 70 percent of the

population suffers from gastrointestinal illnesses, mainly due to the lack of potable water, this reforestation program makes a major contribution to the health program of the 26,000 people living some day's drive from the capital city of Colombia. The program has also generated some 160 jobs in a region where there has been a chronic shortage of jobs.

Fifth, the system is to search for improved productivity of material and energy sources, by incorporating waste by-products back into the system. SL starts from natural, biological, social, human and physical assets and as long as one or several of these are not used to their full potential, this society cannot have achieved its best. This implies that prior to the introduction of new products and services, one first searches for the technologies which will improve the efficiency and the opportunities inherent to the available resources.

From Beer to soap

A beer brewer only uses the starch in the barley, the rest which includes 70 percent fibers and 26 percent protein is considered waste. How could protein ever be considered a waste? The breweries typically give the spent grain to pig or cattle farmers which buy this at low cost. If on the other hand the spent grain is used to farm mushrooms then the lignocellulose will be broken down and the substrate enriched with protein (this has been scientifically demonstrated on three continents),. This protein-rich material is an excellent breeding ground for earthworms. The earthworms can be harvested and simple equipment, requiring no more than a voltage of 50w, will permit the separation of the enzymes into five categories. These five varieties are of high quality and purity and could be used as an additive to the local soaps which until then could not compete against the synthetic soap promoted by the multinational corporations. All this generates jobs, keeps the local soap industry competitive and eliminates pollution from the brewery while recovering protein and generating additional nutrients. This is an example of how economies of scope can work in reality thanks to a systems approach which develops technologies tailored to the priorities of the market.

Technologies must focus on the full use of the available materials and increasing the productivity of these resources. The SL program starts with an assessment of what people have and this participative program permits the identification of the technologies which could improve productivity of all available assets. But the poor do not always have access to all the assets they require to get themselves out of poverty. Hence, the technology strategy must be developed in parallel with a strategy that improves access to assets not currently available (see chapters on policy and governance in this primer).

Fortunately, communities in developing nations in general have a great sense of the necessity to reuse materials. Their approach to waste is remarkable compared to the wasteful practices in the industrialized world. Still, opportunities for better utilization of waste could be envisaged. Straw, husks and cobs for example are in abundance in farming regions. Presently, these are used as fuel, incinerated on the farm land itself, or just left to rot on the field, but they can also be used for example, as substrates for mushroom farming or as a rich source of fibers for

paper making. Another example are the leaves from fruit plantations, like bananas, which are rich in single cell proteins and could be converted into animal feed or even infant food.

Survival in the Namib Desert

To the uninformed observer it seems that there is no hope for survival in this region, since no assets are readily identifiable. The best symbol for making everything out of nothing, even when it seems that there is nothing at all, is the story of the *Welwitschia mirabilis.* This plant, which has survived the Namib desert for centuries, evolved the technique of humidity harvesting and small animals chew on its leaves since it is the only source of moisture in the area. This unique plant not only survives the harsh desert conditions, it is the oldest living plant species on record. Some individual Welwitchia plants still living in the Namib desert are over 2,000 years old.

The capacity of the *Welwitchia mirabilis* has been used as an inspiration for the economic development of the desert coastal zones in Namibia. Fog harvesting, based on the access to the cold surface water of the Cold Benguela Current, has been an important component in the identification of water sources. Desalination or distillation techniques were too expensive, whereas fog harvesting systems, similar to the one practiced by the *W. mirabilis,* allow local farming using the innovative drip irrigation technique.

Furfural and enzymes

Large plantations generate millions of tons of biomass waste. A palm oil plantation typically produces between 8 and 20 tons of solid waste per year. The leaves in particular are a major nuisance. They used to be incinerated, but since the smoke screen could block air traffic for weeks, and since the carbon dioxide emissions would reach unacceptable levels, there has been a tendency to plow the biowaste back into the soil. This acts as a soil conditioner and some even claim a soil enricher. The idea that this is so comes from temperate climate zones where the waste foliage has a very small incidence of furfural (less than 4 percent), an anti-enzymatic compound naturally occurring in the leaves. In the tropics, the concentration of furfural can reach up to 17 percent. If the leaves are plowed into the soil, then it will inhibit all enzymatic activity, slowing down the degradation considerably, and instead of a soil conditioning, it could be called a soil destabilizer. If on the other hand, one were to extract the furfural on the basis of simple techniques with readily available technologies, and then reapply the waste from the extraction process to the soil then the residue would be a good soil conditioner since it has been deprived of all the anti-enzymatic ingredients; and one would have a valuable by-product which fetches a good price on the open market (+ US$ 1,000/Ton).

Sixth, there is a need to transform the national scientific and training infrastructure to reflect the fact that the complex needs associated with an ecosystem requires a multi-disciplinary approach. Training and education systems should be encouraged to adjust to this new multi disciplinary approach as well.

Faculty of Agriculture and Natural Resources of the University of Namibia

After independence, the Government of Namibia founded the University of Namibia. The majority of the population is engaged in subsistence farming therefore the Vice Chancellor of the University decided to establish the Faculty of Agriculture and Natural Resources. This faculty is not organized according to the traditional sectors of plant, fish and animal science, but has instead opted to use the integrated biosystems approach as the core of its research and training. The University has been instrumental in researching the use of spent grain from the local brewery as substrate for mushrooms; it has studied local fresh water fish species to grow in a poly-fish culture fed by agro-industrial effluent which had been pretreated anaerobically through a digester. The Faculty is located 40 kilometers outside the city, and has received three farms as private sector donations where the vision of the IBS will be used as the core driving principles.

At the same time, it is necessary to ensure that there is a degree of complementary between research at the national and international level (i.e.CGIAR).

The study of fungal germoplasm

Research into mushrooms has not been done at the international level. But since macro and micro fungi play a critical part in the ecosystem, it has been taken up by a series of newly established centers with a regional vocation. The Governments of Cameroon, Namibia, Tanzania and Colombia have decided to take the initiative to establish regional spore banks and undertake detailed taxonomic studies, followed by programs to collect and propagate those species which have immediate relevance for local farming.

2. The Framework for TSSL

This section will seek to outline a broad framework, which can facilitate alignment of action at the 3 main organizational levels in the public administrative structure (national, meso, and local). Such an alignment can greatly facilitate the difficult task that marginalized communities face and community level strategies that are formulated with this in mind have a better chance of optimizing the support from the Government.

A Three Tier Framework

Most countries have 3 main levels of Government, viz.: the national, meso (state, district, county) and local (municipality, block, community, village) levels. The balance between and among these levels is a central political issue. In developing countries the national level often plays a very dominant role and in many places the local level has largely atrophied. Decentralization schemes have been initiated in many countries to address this problem and the SL approach is designed to go a step further by empowering the people at the local level and enabling them to play a pro-active role (see chapter on governance).

The meso level holds the potential to foster alignment between local level

initiatives and the policies, regulation, and resource allocation at the national level. It is also the level that can back up technological support and capacity building (to be provided by NGOs etc.) in the most cost effective manner. Institutions and administrative units at this level are vertically linked to the national level but need to reach out to, or strengthen, their links with the local level. Moreover, horizontal linkages must be established with similar institutions in other parts of the country for cross-fertilization of experience. Services from these institutions can be integrated at the local level via the SL program and through coordinating bodies set up to implement the SL plan (see chapter on governance).

Finally, the national level is required to give strategic direction to the development and diffusion of technology, to carry out regulatory functions and to ensure that the macro-economic environment is stable and supportive (for instance by ensuring terms of trade that provide the right signals) (see chapter on policy and on Governance).

The glue that can tie action at these levels together is a shared vision fed by free information flows and aided by good working links between the stakeholders involved in the TSSL at all levels. Alignment must come over a period of time in response to 1) clearer situation analysis, planning and action at the local level, and 2) setting of strategic goals (linked with specific indicators) at the national level in light of global opportunities. This alignment will come about as each level learns to play the new role assigned to it under a decentralized approach.

Learning is linked to action so pilot and demonstration schemes remain the best tools for introducing new technology and organizational changes. But such schemes should 'bubble' up and out from the community level through voluntary interaction and emulation, they should not be imposed by bureaucrats at the national or meso levels.

This type of multiplier is closely linked with networking and the formation of social capital. It would require organized support (i.e. the provision of hardware) and encouragement initially. Various media can be used, including ICT's, newsletters and piggybacking on traditional entertainment. Comparisons with other communities can be powerful motivators and could, for instance, be promoted via regular announcement/publication of community level performance indicators. The ranking that takes place in the UN's HDR index gets peoples attention and helps to motivate action for improvement. As part of the implementation of the SL approach, efforts should therefore be made to identify simple indicators of community well being and to carry out simple benchmarking studies that can show how the technology and organization has been used to achieve better livelihoods. Visits to high performers can further help to spur interest and development.

Meso-level institutions could play a supporting role by compiling and disseminating such indicators, which at the same time could be used to plan and facilitate their support work. Collection of information should also be geared toward strategic national needs and serve as a means of monitoring or informing the formulation of a technology policy.

A TSSL therefore requires action at all 3 levels of the framework, this would include:

National level

- Formulation and adoption of technology policies. Ideally, a national policy would outline strategic goals for national R&D, introduce rules and incentives for collaboration between public and private sector on R&D, determine the nature and scope of extension systems, including ICT's, and their funding and outline measures of direct support.
- Research and development of technologies at government scientific institutes, universities
- and research centers.
- Creation of a favorable climate for investment at the local level. This is sine qua non for SL. Government officers from relevant ministries and representatives from the private sector should be consulted and included in the design of the technology strategy. Government officers who are fully aware of the effects of government legislation and institutions on technology development at the grass roots community level will be more inclined to make changes in government policy that can facilitate the TSSL. While private sector involvement will help in the identification of technology development which can be passed onto private companies.
- Promotion of networking. This is key to the coordination of relevant stakeholders who are involved in the TSSL so that information can be shared. Wherever possible, modern ICT's should be promoted and adopted in developing countries this will improve access to information and lead to improved networking, the cross fertilsation of ideas and best practices. This amounts to building social capital.

Meso-level

- Institutional support. Networks that can provide technology and managerial support to small and micro enterprises at the community level, including agricultural extension in the form of model or experimental farms, must be established as close to the local level as possible. Piggybacking on educational institutions, including universities, high schools etc. should be encouraged to the fullest extent possible and close linkages should be built between specialized institutions at the meso-level and extension or community centers to strengthen technical services across communities. Maximum use should be made of NGOs and non-profit agencies for capacity building services with back up from the meso-level institutions. Contracts should be given on a commercial basis and user fees should be introduced as soon as small holders and small industries can pay.
- Information sharing. Institutions should collect data and produce and disseminate comparative studies that can serve as the basis for identification of best practices. They should also support planning at the local level by providing relevant data that can serve as a basis for sound assessment of resources and present technology levels and policies.
- Documentation of indigenous knowledge. Meso-level institutions should

help to establish knowledge bases as well as networks with local individuals and organizations at the community level that are involved in innovation. They should be a main conduit to national level institutions/expertise and so facilitate knowledge mining.
- Special investment and development institutions may have to be set up to encourage investment.

Local level (communities)

- Establishing of planning and coordination capacity at the community level. This could be done through contracting with an NGO but must involve training of leaders (vision), planners/coordinators and representatives from all sections of the local community.
- Assessment of the technology level, needs and constraints, including regulations and laws. This should be framed on the basis of the information available in various public and civil society organizations. Where possible full use should be made of remote sensing data and GIS for compilation of a full picture of the production potential based on natural resources.
- Integration of technology issues into the local action plan. Such plans should identify the most promising areas for specific and generic interventions and spell out an approach. This could involve various combinations of technologies and where possible waste by products should be reintegrated back into the system.
- Facilitating networking. Where many individuals are engaged in similar activities and produce similar products for the market, efforts should be made to organize networks to facilitate the transfer of best practices and ideas.

The above listing should actually be put on its head since the perspective of SL essentially is bottom up. As an honest development broker, UNDP can help to ensure that an overall coherent framework will emerge. This could be done via advocacy as well as separate program interventions under the CCF. In his/her role as Resident Coordinator for the UN system the Resident Representative could also be instrumental in raising issues of technology transfer and development at the Development Forum and Round Table meetings, which, inter alia, could be used to secure support from other donors for such efforts. Where national programs do exist in the areas of SMEs, renewable energy, IT, and technology management, UNDP could help to assess their effectiveness and to bring in global experience to help address shortcomings.

Example of national-meso-local linkage: Asian Ecotechnology Network

The Asian Ecotechnology Network was launched in February 1996. This network functions in association with the UNESCO-Cousteau Chair in Ecotechnology. The network brings together brings together governments, universities and research institutes with the goal of promoting capacity-building to enable the blending of traditional local community technologies and frontline modern technology developments. The network has a dynamic curriculum

design to capture on going ecotechnology developments. Ecotechnology involves blending frontier technologies such as information, space and bio technologies with the ecological prudence and practices of local communities. Such technology blending is done jointly with rural families in a participatory research mode in whole villages, termed Biovillages, which are laboratories for "ecotechnology in action". The ICAR-MSSRF Integrated Pest Management Centre develops and promotes the use of low cost integrated pest management systems in cotton, ground nuts, soybean and rice.

3. Improving linkages between stakeholders in a TSSL.

For a TSSL to be effective, good links need to be established between all the stakeholders involved in technology development. These links will allow improved access to knowledge, ideas and new technologies and bring additional resources into the TSSL. The major stakeholders include the local community, non-governmental organizations, provincial, national and international research institutes and government organizations. There are a number of institutional obstacles which exist between stakeholders which will need to be overcome in order to improve linkages. Although the extent and type of obstacles will vary according to the country and region of the TSSL, common obstacles and appropriate action are listed in table 2 (see chapter on participation).

Table 2: Improving linkages between stakeholders

Obstacles	Action
Cultural and institutional barriers restricting effective participation by the local community in technology strategy development.	• Ensure community participation in the design of research projects. • Arrange for community representation in technology development meetings held at the provincial, national and international level. • Feedback from outside stakeholders to the community should be presented so that information is readily accessible and understandable e.g.: posters, flip charts, practical demonstrations, comics.
Negative stereotypes, especially between NGO's and GO's and between local communities and GO's.	• Technology development meetings held between stakeholders can be facilitated by neutral third parties. • Encourage familiarity; ensure that when stakeholders visit each other (i.e.: in the community villages, research institutes, government offices etc.) a significant amount of time is set aside- discourage 'in and out' morning or afternoon only visits.
Competition for resources and recognition, especially between provincial, national and international research organizations.	• Arrange exchange visits (ideally lasting between 1 week to 1 month) for scientists from regional, national, international and government institutes i.e. a government scientist working at a provincial

	institute)
Poor communication systems	• Networks can be set up between stakeholders through the introduction and promotion of ICT's
Differences between all the stakeholders in terms of their operational procedures, scale and philosophy.	• Ensure that stakeholders clearly understand that the *objective* is technology that is relevant, appropriate and affordable for the local community. • These differences can be an asset, a TSSL should exploit the comparative advantages of the various stakeholders, these include: - Local communities knowledge of indigenous technologies and local environmental and socio-economic conditions. - National and provincial research institutes knowledge of local environmental and socio-economic conditions. Also, researchers from these institutes often share the same culture and language of the local community. - International research institutes access to state of the art research facilities and ability to appropriate funding. -Government's ability to facilitate a TSSL by creating favorable conditions for technology development.

4. Ensuring Community Participation in Technology Development

The TSSL must be focused on the assets, strengths and livelihoods of the community. To realize this it will be necessary for that community to play a central role in the technology development strategy. Effective community participation in the technology development strategy will ensure that outside technology and know-how does not dominate in the development process. Traditionally, an outside team of researchers would be brought in to survey a community and the information from this would then be used to develop technology for this community. In this scenario the community members are informants while the outsider researchers are the analysts. This traditional 'extractive' process needs to be changed into a more participatory process. To ensure this, a transition is needed whereby the outsider/ analysts become facilitators in the development process while the community members become the researchers/ analysts (A. Norton 1998). The following points must be considered when designing a TSSL:

- Politics. A technology development strategy must acknowledge the political nature of participatory development. For a number of reasons (ethnicity, religion etc.) a community may be marginalized in the political and institutional sectors of their country. This will hinder a communities participation in a development strategy especially at the meso and national

level. In response to these issues, action is needed to ensure the empowerment of the community within institutions in which they were previously marginalized. For example, a development organization (Village aid) working in the Northwestern province of a west African country, where the government is attempting to suppress ethnically based movements, has a programme which aims at political empowerment of the local community within state structures. Specific action includes the linking of communities so that they have a more influential presence within meso and national level institutions. Village aiD is focusing on longer term democratic and human rights issues together alongside the technical issues of their village projects (G.Mohan 1998).

- Responsibilities. It should be made clear to all stakeholders that the prime responsibility for the direction of the technology strategy lies with the local community.
- Team composition. Teams of western analysts descending on a community often distract from the matter in hand. Ideally the outsider/researcher team should be of the same culture/nationality as the community. A small team comprising university graduates and/ or people with experience of working with non-governmental organisations with expertise in technology issues related to the community livelihoods should be put together in country and trained in participatory research methods and group facilitation techniques.
- Representation. The development of a technology strategy will involve stakeholder meetings at the local, meso, national and international level. To ensure representation and feedback the community must participate in these meetings. At the meso and national level representatives from the communities should be present at the meetings, at the international level there should be a person nominated by the local community to represent them at meetings.
- Community's need up to date information on all aspects of the technology strategy. Local communication methods have to be identified to pass on such information (i.e. through song, plays, news letters etc.. Modern information technologies can also be harnessed where feasible.

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Information Villages are being established to bring the benefits of cyber space to rural women and men. Computer-aided information systems, operated by local women and men in Tamil, are providing demand-driven information. Such information empowerment holds the key to getting the benefits of government programme and new technologies to those who are being bypassed by both the regular extension services and the emerging information super highway. The first Information Village was inaugurated in February 1998 by Dr Ismail Serageldin, Chairman of the Consultative Group on International Agricultural Research, at Villianur village in the Union Territory of Pondicherry. A major aim of the Information Village programme is the training of a work force capable of developing and providing the value-added products and services required by the fast information and knowledge based economy (from: http://www.mssrf.org).

5. Organizational Systems and Technology

This refers to those technologies which facilitate livelihood activities. Particularly important are those technologies which facilitate marketing and distribution and increase access to information. Improving access to information, via ICT's, is crucial to the success of a TSSL. ICT's are needed to create effective networks which allow for knowledge and best practices to be shared between stakeholders in the technology strategy. In order to make networks more efficient, the TSSL should focus on developing modalities with regards to ICT's.

Marketing and distribution are typically responsible for over 90 percent of the value added to a product in the market. The coffee farmer in Colombia or the Palm oil producer in the Philippines knows all too well that the price paid by the consumer in the industrialized world is only a fraction of the sales price of his quality produce. Unfortunately, developing countries have focused their technology strategy mostly on the production side while insufficient attention has been paid to the supply side in technology strategies. For example, a simple canning/ plastic wrap packaging machine for a farmers pineapple cooperative would allow the farmers to store produce for sale during periods of high pineapple price.

Detergents from citrus waste

The cultivation and processing of citrus fruits generates a lot of waste. Sometimes this is given to cattle, on most occasions it is discarded. This waste can, however, be processed into active ingredients for detergents. The investment is high and the competition is tight. The market is controlled by a few multinational corporations. In addition, the value added generated by the citrus extract in the detergent is limited to a mere 3-4 percent. Therefore, it would be better to first concentrate on the area where the largest share of the value added is generated: distribution.

The initiators of the project could first establish a three level distribution system: one mixing the citrus concentrate purchased on the market with water, a second level of several persons bottling these concentrates in 50 liter tanks and a third selling one liter bottles with a ratio of one bottler for every six sales persons. This network marketing will generate sales, and appropriate the largest share of the value added. Once the volume of sales reaches a threshold of one million dollars, the investment in the citrus processing facility is justified. At that moment, the risk in investment is low since the community already has a niche in the market. The return on investment will be high, the financing likely and the overall generation of value added will be in the hands of the many who collaborate in this project. Just as one patent or one technique on its own can make a valuable contribution, its overall impact is much more beneficial when the downstream generation of value added is considered

6. From Strategy to Action

In line with the community entry point that is embodied in the SL approach, UNDP will focus on technology transfer and development for the local level. The objective is to pilot workable technology cum organizational solutions in the context of holistic SL community interventions. This often involves intense effort as linkages with the other levels must be developed from scratch and on an ad hoc basis to resolve the problems identified. Such interventions will be more concerned with learning than with cost effectiveness, but the lessons learned can form the basis for more systematic capacity building efforts in support of future local initiatives. Entry points will of course vary from place to place and country to country. The level of development of a given community is important as it determines the need for support and for entry points and goal setting. The initial set of assessments that the SL approach is based on must be applied with thoroughness and stakeholder involvement in planning and action is essential.

Interventions by UNDP at the local level often cover a number of communities in a given geographical area. This gives an opportunity to capture the diversity of approaches and can form an initial platform for cross-fertilization of ideas. A variety of technology pilots can be initiated and various organizational arrangements tested.

Areas of intervention for the technology strategy should be based on the underlying principles of the SL concept. These principles together with appropriate action are shown in table 4.

Table 4: Entry points and action for the technology strategy

SL principle	Action
Participatory	• A participatory assessment to determine local assets, entitlements, adaptive strategies and local technologies. Based on this information, and guided by the principles outlined above, an assessment by local 'experts' of appropriate science and technology inputs is carried out. The assessment is discussed between the local people and the local experts with appropriate facilitation, and the action plans modified accordingly. Technologies should be tailored to the assets of the community which they are to serve and outside technology should complement indigenous knowledge. For communities living in poverty however, the aim of technology development is to improve, and contribute to, sustainable livelihoods rather than achieve the narrow goal of economic growth. • Promote networking across the population of communities including through Communities of Practice. For local communities, this does not necessarily require IT but can rely on available media, such as radio, newsletters, newspapers, direct interaction (meetings) etc.. CoP's can be set up to bring together the lessons learnt and best practices of relevant stakeholders involved in technology development globally. The structuring of information can make use of modern information processing technologies and the fine-tuning of the technologies and CoP's can be done through sounding boards which are easily organized over the Internet. Many communities do not have access to Internet or advanced processing information systems, but an effort can be made to bring the information to the place where it is most needed. A telephone line in rural Sri Lanka

	permits the farmer to remain informed on the price for coconuts on the Colombo Exchange, thus enabling a better negotiation with buyers. Realistically, the project manager in the field will have to make an assessment as to whether the extent and/ or reliability of electrification justifies installing new communication technologies.
Focus on Strengths	• The strategy should build on effective indigenous technologies. In the strategy design one must examine how modern technologies can strengthen traditional technologies, and how traditional technologies could enhance modern approaches. In a systems approach, one wishes to identify the optimal combinations of indigenous and outside technologies.
Equity	• Before any new technology is introduced, an assessment is needed to determine the impact on vulnerable and marginalised groups in the community. At the minimum this will involve completing a gender analysis. Often, the easiest entry point will be through the elite group in the community i.e. village headmen, this is likely to result in the technologies subsequently being appropriated by the elite and should be avoided. • The TSSL must abide by the legal framework surrounding Intellectual Property Rights (IPR) relevant to technology. However, organisations such as UNDP can engage in advocacy to ensure that relevant international and national law is fair for local communities.
Flexibility	• Technologies should be tailored to the specific socio economic and agro-ecological environment faced by each community. • Technologies should be tested at demonstration sites within the community before their general introduction. This will help to ensure that technologies are suitable and practical demonstrations will increase the communities confidence in the technology. Time and resources permitting, the identification of new technologies can be subjected to a simulation. This modeling exercise permits the identification of new opportunities in uncharted territories. This is necessary since the introduction of new technologies will have a profound effect which goes beyond the immediate and verifiable impact of generating new wealth. Since the focus is on sustainability, one must study the effects on future generations in order to avoid environmental and social havoc. Mathematical modeling and computer simulations will require input from the local communities involved in the SL program. There are a variety of computer modeling programs available, one such package is 'STELLA' a program which builds capacity for understanding dynamic interrelationships within biological, social and physical systems (for more information check the internet at http://www.hps-inc.com/products/STELLA/STELLA.html)
Environmental sustainability	• The technology strategy must encourage the adoption of environmentally friendly technologies. For ways on how this can be achieved see the Investment chapter, section 6 'environmental sustainability'.
Macro- micro linkages	• An efficient networking capacity should be developed to enhance the interaction between stakeholders in the TSSL. The introduction and promotion of ICT's is an important part of this process. UNDP is currently involved in setting up Telecentres in local communities.

	These telecenters have a fax, telephone and internet access and can be run on solar power where electricity is absent/ erratic. The investment costs can be recovered through user fee's charged to users of the centers. • SMME's bridge the gap between communities and institutions at the meso level. Capacity for developing technological solutions to promote Sustainable Livelihoods can be built through SMME's (small, medium, and micro enterprises) whose development can be facilitated by agencies such as UNDP.
Stability	• Technologies must be robust to outside shocks and stresses. During the participatory assessment stage of the SL process, shocks and stresses likely to be faced by the community have to be identified and technologies adapted to cope with these (see chapter on participatory assessment).
Innovation	• Many of the principles and approaches featured in the new business literature on learning and knowledge management apply equally well to the situation at the community level. In an (increasingly) specialized production system, farmers, entrepreneurs and business managers will have to become more market savvy and demand driven. This involves SMME's adopting the following business system principles: - Serve the customer, know his needs and desires and respond. - Adopt a long term horizon this encourages proactive rather than reactive management. - Promote permeability – create an outward looking culture – share/disseminate information – encourage networking with other businesses/communities etc. - Promote innovation (new services and products) as this is the main source of competitive advantage in the global society where information is readily available. Instill an experimental and entrepreneurial attitude (culture). - Build on what is already there – and don't reinvent the wheel – build partnerships even with organizations that may also be competitors in other areas. - Emphasize win-win solutions –SMME's have social obligations just as the community or Government has a role to promote/facilitate private enterprise. The daily personal interaction in local communities makes the importance of building social capital evident. Given the universal character of these principles it may be useful to attempt to systematically involve Business Schools as well as National Chambers of Commerce and individual companies that wish to give something back to the community in pilot schemes. This would be in conformity with the slogan: "Think globally, act locally".
Monitoring & Evaluation	• A technology strategy is a constantly evolving process. The technology strategy should be modified as lessons are learnt and new technologies are developed and discovered. See also chapter on

	indicators and M& E.

To conclude

If a technology strategy adopts the principles outlined in this chapter, then the technology solutions developed will have 6 key characteristics, all of which improve the technologies sustainability and impact on livelihoods :

(1) Technology will be based on the needs of the specific social, environmental and climatological conditions of local communities.

(2) Technology will blend local with international technologies which will help to make the best use of the available know-how and capital base of the communities one aims to develop. Advanced research and development globally can be drawn upon, through the use of ICT's for example.

(3) Technology will be refined through a participatory process, since in an SL program local solutions, assets and ideas are central to the development of the TSSL.

(4) Technology will be integrated and networked in that it creates a connection between regional, national and international science and technology stakeholders and the poor;

(5) Technology will be flexible in response to changes in the socio-economic and environmental conditions;

(6) Technology will be empowering to communities especially so for the vulnerable groups within the community.

The success of any TSSL methodology, be it for business or for community development, depends on its applicability to differing social, economic, cultural and climatological circumstances.