SATNET electronic discussion no. 2

How do we evaluate the suitability of agricultural technologies to be disseminated through SATNET Asia?

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Background

SATNET Asia is developing a portfolio of agricultural technologies, practices, concepts or ideas that are sustainable, productivity-enhancing and appropriate for the poorest and most vulnerable people of South and Southeast Asia. The Food Security Center (FSC) of the University of Hohenheim in Germany has drafted an analytical framework suggesting a set of criteria that can be used to evaluate the suitability of technologies to be disseminated through the project. These criteria have been organized into four topics as follows: (i) **environment** – benefits and risks to environment; impact on local biodiversity and natural biological processes; carbon sequestration, global warming potential and acidification potential; output and input ratio; total energy use; share of renewable energy; water use; share of off-site inputs; waste for disposal, recycling and wastewater; (ii) **economy** – gross margin per time invested; benefits and risks to economy; (iii) **society** – benefits and risks to society; ownership of agricultural land required; share of female adopters; risk of disturbance; persons involved; payment of persons involved; and (iv) **technology** – comparative advantage; initial investment costs and expected life cycle. Based on these suggested criteria, SATNET forum participants discussed the following:

1. Does the framework cover the most relevant criteria for the evaluation of technologies against the aims of SATNET Asia?
2. Are any important criteria missing?
3. Are there criteria included that are of minor importance or for which information would be very difficult to collect?

General comments

Participants noted that when designing a questionnaire we need to ask ourselves "What minimum data do we need for what we want to achieve?" In the context of criteria for the evaluation of technologies, we need to know what minimum questions we need to ask to determine the value of a technology. We also need to ask ourselves "How would 'I' respond to this question?" "Would I be able to provide details such as input-output ratio or percentage share of renewable energy?" If not, there is a risk of obtaining "guesstimates" because data might not be available or may be very difficult to obtain. In such cases, it would be better to remove the concerned item as it might not be credible. Since ranking will never be easy, naming the drawbacks of a technology in order to discover and describe the prerequisites and circumstances under which new technologies work is probably the most important aspect of the whole evaluation.

Before the questionnaire is sent out, it is also important to clarify who will use the criteria to evaluate different technologies. "Will it be experts or farmers?" "What database will be available for the technologies?" "How do we find the right data?" "Will they be based on interviews with farmers?" "Will NGOs provide the data?" "Will the evaluation be qualitative?" "Will certain technologies be evaluated through case studies with additional analyses such as in the lab or in the field?" These questions can determine which criteria should be chosen.

We should also remember that technology per se is a tool to achieve improvements. So while the specific topics against which proposed technologies are to be evaluated – environment (sustainability), economy (income) and society (empowerment) – are very relevant in terms of how technologies contribute to their improvement, it seems that point (iv) – technology – does not belong to these criteria.

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There is also some concern that the attributes of these criteria are too detailed and that it might be time-consuming to address all aspects. There was a suggestion that the criteria need to be consolidated, otherwise there is a risk that respondents might be overwhelmed by the level of detail and reluctant to fill in the questionnaire. Some attributes such as benefits and risks to environment seem to be complementary, especially when a ranking scale is used. For example, if something is beneficial but also carries a certain risk, then the ranking would be somewhere below the maximum of the ranking scale.

Does the framework cover the most relevant criteria for the evaluation of technologies against the aims of SATNET Asia?

Generally, respondents agreed that the framework covers relevant criteria. However, some important points were made. There was some concern that measuring only production as an indicator for improved technology may have limited implications. A holistic cost-benefit analysis also considering reduction in cost of inputs, decreased labour, and decreased seed requirement, must be considered. Other comments referred to technology acceptance by farmers, ecological and economic sustainability, and society, as outlined below.

Are any important criteria missing?

Technology sustainability

Acceptance of technologies by farmers is one of the important elements of ensuring sustainability of new technologies. Experience of working with small landholders in India has shown that farmers have their own assessment parameters as far as accepting new technology is concerned. Some of these parameters can be very specific to their overall household needs and difficult for researchers and programme designers to foresee. The level of acceptance depends on cost and benefits to farmers (see section on economic sustainability) and whether this technology is **addressing farmers' and women's needs**. For instance, technology that increases women's labour burden might have limited acceptance. Hence the workload factor and gender issues also need to be considered.

Another important element is the enabling **infrastructure** in order for technologies to be used and sustained. For example, many farmers in India do not have access to soil testing laboratories so promoting this technology without looking into the infrastructure will not yield sustainable results. On the other hand, materials required for multiplication of beneficial microbes for eco-friendly composting, including dung, cattle urine, farm waste, city waste and water, may be easily available in any community.

Furthermore, more than technologies per se, the medium of **technology transfer** is very critical in determining the level of adoption. How will the technology reach farmers? Demonstration plots at the farmer level are a very important medium as farmers see the impact of technology in their own conditions and among their peers. This increases the farmer's confidence to try new practices in his/her own fields. Mediums such as classroom sessions have limited impact unless they are combined with demonstration plots.

Environmental/ecological sustainability

The enabling environment should be assessed to ensure ecological sustainability as technologies may be very specific to different sites and groups of actors. For example, new technologies must be appropriate to topography and climate. While water-intensive technology can work in humid climates, it may be problematic in dry areas.

Plant nutrient and plant protection problems should be managed through eco-friendly, sustainable and cost-effective technologies based on the use of mixed culture of beneficial microbes. Such technologies should be disseminated through SATNET. For **cost-effective plant nutrition**, locally available resources should be converted into high valuable inputs through eco-friendly, sustainable and cost effective technology. For example, locally available compost having 0.5% nitrogen should be converted into 2-4% nitrogen through the use of mixed culture of beneficial microbes. Moreover, the technology should add another solubilizing nutrient and soil insect pest- and disease-controlling microbes. For **cost-effective plant protection**, the mixed culture of beneficial microbes should be able to be multiplied in cattle urine, cattle dung and water. Such fermented decoction should be effective to control any insect pests, diseases and nutrients deficiencies, including nematodes and viruses. There has been some concern that a plant protection method that involves a lot of hand work may be beneficial for the environment and food security but it may require a higher workload for women.

However, in Nepal for example, most farmers use chemical pesticides to protect plants. These are harmful to both human health and the environment, with several casualties/deaths reported every year. There are also many pest problems that cannot be controlled and managed by using chemical pesticides. Thus farmers, both men and women, are spending huge amounts of money and bearing heavy workloads that are resulting in unsustainable farming systems as well as endangered eco-systems. Once farmers replace the use of chemicals with beneficial microbes for plant protection that are eco- and human-friendly, they will have more sustainable farming systems and reduced workloads as these microbes continue multiplying.

More attention also needs to be paid to technology that is capable of increasing the soil organic matter not only to enhance crop productivity but also to **reduce the adverse effects of climate change** through increased carbon sequestering. The need for mixed culture of beneficial microbes should decrease in subsequent years as the microbes continue multiplying in the farming systems.

Economic sustainability

The enabling environment for economic sustainability of technologies must be assessed as well. Cost effectiveness and initial affordability is key to farmer acceptance of a new technology. One element that was found missing among the economic attributes in the framework is the return on investment, which defines the economic sustainability of a technology. If the promoted technology does not bring desired benefits to farmers, it becomes unsustainable.

If we introduce and supply drought-resistant varieties to farmers through a project, there must be a **locally-established supply system** (traders) which can supply these seeds even after the project ends. Otherwise the technology transfer remains incomplete and unsustainable. Therefore, both the supply and demand sides need to be addressed.

While ecological sustainability is a key issue, it should not come with a huge yield penalty. For instance, converting to 100 per cent organic inputs from year 1 reduces the farm production. Unless conversion to organic farming is incentivised, farmers would have little motivation to adopt these practices. So an ideal mixture of technologies and appropriate **incentives** that does not reduce the production of smallholders in a significant way should be promoted. However, such a mix should minimize the chances of chemical contamination which kill the beneficial microbes. Therefore, the disseminated technology should be eco-friendly. Global warming and acidification are macro level issues and for small farmers food security is the primary concern. Both concerns need to be handled appropriately.

Society

Benefits, risks, land ownership, share of women adopters, persons involved, etc. are all relevant attributes for evaluating technologies. However, there are other attributes that influence the level of technology adoption. For example, technologies need to be **simple to be understood** by any illiterate person. **Perceptions** such as whether they are non-poisonous and eco-friendly play a role in terms of technology adoption rates.

Based on experiences in technology dissemination in Indonesia, **ownership and inclusion** in communication processes by all stakeholders (farmers, researchers, extension officers, local authorities, etc.) are important. All stakeholders need to be involved and see that their aspirations are incorporated in activities and that they have a stake in influencing and shaping the direction of an activity.

Farmers' **empowerment** needs to be assessed through their capacities to identify their own problems and develop their own solutions. In Indonesia, for example, through such capacities, farmers built their confidence in independent decision-making, which allowed them to assess and adapt innovations to suit their specific agro-ecological and socio-economic conditions.

Processes that would sustain achievements after the life of a project need to be put in place to monitor the extent to which supportive systems are established to facilitate inclusive participation that brings about positive change. For example, dialogue amongst stakeholders is well developed; support is received from local authorities through policies addressing farmers' needs; and stakeholders are motivated to continue their activities once the funding of their project has finished.

Are there criteria included that are of minor importance or for which information would be very difficult to collect?

Some of the criteria such as the carbon sequestration potential of a certain technology are difficult to assess. Even if a lot of organic matter is applied in a certain agricultural system, the carbon sequestration potential may be zero if other measures that enhance soil mineralization are also included. The two (or more) sides of a technology might be very hard to discover particularly for the environment-related criteria. There are also different views on carbon sequestration. On the one hand, there is a concern that as soon as more organic matter is contained in the soil, the risk for N2O emissions is rising. On the other hand, there is a view that a one per cent increase of organic matter in soil sequesters 88 tonnes of carbon dioxide and carbon trading can be promoted. So how do we evaluate the global warming potential for the technology? Without a high level of analytical effort this question cannot be answered.

There is also a risk of falling into the trap of making easy assumptions and extrapolating what one thinks will happen without evidence. Therefore, it might be better to use general criteria within the environment category and describe the potential risks for water, soil, air, biodiversity without providing too much detail that would be very hard to assess.