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Dealing with Uncertainty with Certain Principles, and mobilizing Farmers' Creativity for Sustainable Agriculture Intensification that Contributes to Food Security

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Opinion

Although total global food production over the past half century kept ahead of global demand, around one billion people today do not have enough to eat, and a further billion lack adequate nutrition. It was estimated that by 2030, global food demand will need to increase with 50% while the area of cultivated land goes up by only 10%, assuming a yield increase of 40% of the major commodity crops. Increasing food production through gains in productivity thus remains a cornerstone strategy in our efforts to alleviate global food insecurity.

In particular, raising productivity needs attention in agrarian economies where food insecurity is driven by poverty, and where most of the poor people are directly dependent on agriculture for their livelihood. As a matter of fact, almost 75% of smallholding households, who manage 85 percent of the total number of agricultural farms, are suffering from chronic hunger. It is also important to note that a majority of these farmers, lacking access to irrigation, operate under rainfed conditions and confront an increasingly-degraded natural resource base. Climate-change variability puts additional pressure on them to maintain livelihoods and household food security. A 'business as usual' scenario will require large amounts of water and other physical inputs to achieve the global food demand, and less rather than more water is likely to be available.

There is already stiff competition between industries and agriculture for water, so very little room for expansion of large-scale irrigation is available. Groundwater supplies are also limited and limiting. Climate change may further constrain attempts to mobilize necessary water resources, due to predictable declines in rainfall and amplification of extreme events. In addition, scarcity of fertile land is another major constraint along with excessive use of chemicals for desired agricultural growth to meet the future demand.

In the wake of these convergent trends, producing more food with less inputs and by conserving natural resources is one of the key items on the agenda of current agriculture research and development. The High Panel of Experts on Food Security and Nutrition (HLPE) of the Committee on World Food Security (CFS) recommends investing in smallholder agriculture focusing on the following five components:

I. Conservation and enhancement of soil health

II. Sustainable management of all water resources, and launching a "more crop and income per drop of water" movement

III. Extending appropriate technologies and inputs

IV. Providing the needed credit and insurance

V. Ensuring assured and remunerative marketing opportunities

All five components should ideally be addressed. But how to address these components with the smallholding food-insecure population fully involved and benefited is yet to be worked out as smallholders operate under very diverse environmental conditions which are often difficult to understand and satisfy through technological intervention.

The human learning philosophy says that if appropriately 'fuzzy' boundaries are created and if structural design are loosely defined, and if some degree of uncertainty is built into the system, it can impel human being to unfold his power for creativity and productivity. Appreciating that within the farming community there is more potential for problem-solving, innovation, and resource mobilization than usually evident under current organizational structures and stratification, we opted to work with the principles and practices of the System of Rice Intensification (SRI) which are amenable to farmers' experimentation and adaptation. SRI was developed with and for smallholders who have few economic inputs but have some control over their own resources. The purpose of our project intervention was and is to contribute towards food security of smallholder households in the Lower Mekong River Basin who are burdened by climate change together with other biophysical and socio-economic constraints.

This intervention is part of a regional collaborative project which is being implemented in rainfed areas of the Lower Mekong River Basin (LMB) countries (Cambodia, Laos, Vietnam and Thailand). It involves smallholder farmers (including women and landless), researchers, extension personnel, and development professionals along with staff of the respective government ministries (http://www.sri-lmb.ait.asia/). The immediate objective is to produce healthier and more profitable rice crops under rainfed conditions using SRI methods, evaluated and refined through farmers' participatory action research (FPAR). The initiative has been funded by the European Union as a part of its Food Security Thematic Programme of the Global Programme on Agricultural Research for Development

SRI combines various tested crop management practices that modify age-old rice cultivation techniques through skillful management of plants, soils, water and nutrients. Certain SRI agronomic management principles such as transplanting young seedlings, sparser seeding to give the plants more space, avoiding continuous flooding, and applying compost/manure as much as possible--when implemented together have in many countries (>50) resulted in substantial increases in yield while reducing input requirements.

As a part of this regional initiative, a working consortium has been established at the local, national and regional levels involving more than 15 institutions covering 11 food-insecure provinces of the four countries. Utilizing the consortia, in 2014, the first year of project implementation, more than 120 sets of field experiments were carried out at 60 FPAR sites in Cambodia and Thailand, directly involving 3600 farmers. The farmer-led experiments compared results from their current practices with those from plots where SRI principles were integrated and applied and others where farmer combined some of their current local practices with mostly SRI practices (which were termed as SRI-transition, or SRI-T). An evidence-based understanding was sought for how to improve utilization of household resources, considering full demonstrations and assessments of SRI methodology (SRI-demonstration, SRI-D) along with SRI-T in comparison with present resource utilization.

Initial calculation of yields showed an average paddy yield of 5.03 t/ha with SRI-T methods (mostly but not all SRI methods), while with SRI-demonstration methods, the average yield was 6.41 t/ha. These yields were 60% and 100% higher than the average yield with current practices in the region, i.e., 3.14 t/ha, obtained by the same farmers in the same locales. Economic productivity gains (dollars gained/dollars spent per ha) were also calculated, and it was found that economic return (profitability) was greater in rainfed areas compared to irrigated areas along with greater input use efficiency (http://www.aimspress.com/article/10.3934/agrfood.2016.2.102).

Based on this initial success and on the enthusiasm of farmers and other stakeholders involved, in 2015 we expanded field activities in all four countries, and FPARs were implemented at more than 172 sites in 32 districts of 11 provinces, involving more than 5000 farmers directly in the field experimentations. Altogether, 405 experiments were conducted, 163 being locally-adapted SRI demonstrations, which were adapted by the farmers based on the weather pattern-- a relatively long spell of drought --experienced in 2015 and based on the learning and challenges they faced in the preceding year.

The other239 experiments were set up as SRI-T comparisons which were termed as 'learning plots'. The learning plots had a range of combinations of SRI practices together with conventional and/or modified practices. What methods were applied in learning plots was decided not only according to location-specific needs and last year's FPAR results, but also they factored in market considerations (Thailand and Vietnam) and house holds'food demands (Cambodia and Laos).

Analysis of all 405 experiments (both SRI-T and SRI-D) has shown an average paddy yield of 4.72 t/ha, which is 66.5% more than the regional baseline yield. Average net return was 494 US$, which was 93% more than the baseline figure of 256 US$/ha. This calculation was done using farm gate prices and accounting for the cost of all inputs including imputed value of family labour for which farmers do not pay (http://www.sri-lmb.ait.asia/downloads/SRILMB%20Newsletter%20Dec%202016.pdf).

Going through this learning, which is still in progress, it is evident that if farmers get an opportunity to craft their own world, they can contribute a lot to address many global and local issues, such as environmental issue, food security and

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poverty, and they can act as a strong pillar for making society more collaborative and accommodative.

This is evident from the results that the flexibility which SRI has built for the crop production's environment management is fueling innovation and facilitating farmers to developed their own location-specific practices utilizing their household resources more productively. However, this alone cannot address the issue of food security. Globalization has led to an increase in volatility in food price as un for seen economic shocks affect the whole food system and can be exacerbated by the speculative forces able to trade at the regional level and even at the national level, as experienced in Asia, especially for rice. At the individual and household level, food-price instability further damages vulnerable livelihoods, and the farmer's gain that they achieve through their innovative and creative effortscan also disappear such as with the unprecedented 'storm' experienced in 2007-2008.

The key learning is that a knowledge-intensive approach can fuel innovation and can link innovation, enterprises and investment in a focused manner, but this knowledge is not needed only at the farmer level but all along the value chain. This also means that some degree of flexibility needs to be built around at all levels, from plough to plate'. Markets need to be flexible and accommodative to make sure that the farmers who are doing their best to conserve the natural resources and produce more with less are reasonably remunerated for their efforts. The local wisdom and understanding of sustainable management of natural resources for agriculture intensification need to be taken into accoun to understand the local environment.

Based on our engagements with smallholder farmers so far, we also feel that the indicator for defining smallholder farmers need to broadened with a view that their strength (ability to innovate, adjust and conserve natural resources and biodiversity) should be visualized and opportunity should be highlighted. Small holders farmers can be a best partner to redesign the agriculture utilizing the principles of agro ecology.

Farmers of our project areas are looking for some market responsive to the product grown with sustainable practices (less chemical, less water and less soil disturbance), but due to strict certification requirement, which is often align either with "Organic" or "Inorganic" level, make their entry very difficult. Additionally, they operate under rainfed condition, an unpredictable environment, and so they are unable to qualify.

Non-monetary dimension, such as social capital (working in group and helping each other, social cohesion) which is often overlooked in our current development thinking approach, are key elements to strengthen the resilience capacity of smallholders against any extreme events. These non-monetary assets need to be taken into account while assessing the strength of smallholders and their contribution to the society.

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