COMPLICATED AFFAIRS!

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Science, Technology and Livelihoods

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Livelihoods[1]

Livelihoods are highly complicated affairs for the rural poor in the developing countries, dependant on an intricate mix of assets and resources, rights and obligations, and the skills of the farm household. Rural households are also usually complex entities, consisting of different generations, men and women and their offspring, and often extending through brothers and sisters and their families to embrace a considerable number of people.

A rural livelihood may be constructed from:

- Assets – such as land and intangible assets such as rights to grazing or water
- Technology – which can be indigenous or imported
- Skills – which derive from education or be inherent innovativeness
- Markets – input markets for seed and fertilizers and output markets for produce and local or distant labour markets

Livelihoods on the Loess Plateau in China

This Plateau covers a vast area of northwest China, some 640,000 square kilometers extending over six provinces and home to some 90 million people. Its characteristic soil is a very fine and deep wind blown silt that is easily worked and fertile but readily prone to erosion. This area has a long history of settlement during which time over cultivation and misuse has left it highly degraded. In parts it has the appearance of a moonscape, deep eroded gullies cutting into the denuded soil. It is one of the poorest regions of China; 80% of its 139 counties are officially 'poverty counties'. To tackle the twin issues of environmental degradation and poverty alleviation the World Bank has supported two Loess Plateau Watershed Rehabilitation loan projects. This is currently supported by a grant from DFID to help evaluate the project and identify lessons that can be applied to similar projects elsewhere in China and internationally.

There are several interventions under the project including irrigation and construction of water erosion control structures but the key intervention is the creation of better terraces. The traditional terraces are narrow and sloping making them highly prone to water run-off and soil erosion. The Bank project is using well-designed terraces constructed with bulldozers, that are broader, horizontal and slope inwards form the outer wall to the inner. These are apparently very effective at reducing erosion. Above a slope of about 25% the land (in part traditionally terraced) is reforested with local indigenous trees and this is to be left as conservation land.

Evidence from a brief visit and discussions with farmers indicates that there is now much less erosion, crop yields have improved so that surpluses of winter wheat or maize can be now sold and farmers can have more livestock, stall-fed partly from crops grown on the land. Some have also planted fruit trees. Another critical technology has been the introduction of plastic sheeting in various forms. This is used to mulch maize, keeping down weeds and reducing erosion, weatherproofing cowsheds, constructing plastic greenhouses for growing vegetables and flowers for the local markets.

In summary this appears so far to be a success story. Limited appropriate technology has increased production in what seems to be a sustainable fashion, generating a positive cycle of improvements that feed on one another.

What are the properties of livelihoods?

There are four important properties of livelihoods[2]. These are productivity, stability of production, resilience of production and equitability of productivity among household members. Part of the value of these concepts is that they can be measured.

Productivity – can be expressed as yield or income and measured as the output of valued product per unit of resource input.

- Stability – variations in productivity may be due to climatic or other factors and expressed as the constancy of productivity in the face of the normal fluctuations and cycles in the surrounding environment (usually measured from a time series by the coefficient of variation in productivity).
- Resilience – how productivity responds to external forces can be assessed from the pathway of productivity when subject to stress or a shock.
- Equitability – the evenness of distribution of the productivity of the livelihood among the human beneficiaries, i.e. the level of equity that is generated (A common measure is a Lorenz Curve).

These concepts can also be applied to 'community livelihoods" – how productive is a village, how stable and resilient the livelihoods and how well are the products shared in the community.

Trade-offs

In practice these various properties are traded off against each other. High productivity may come at the expense of sustainability or equity, or high sustainability may result in low productivity. This is demonstrated by contrasting two components that are common in Asian livelihoods, the rice field and the home garden[3].

Home gardens are one of the oldest forms of farming system and are particularly well developed in Java. They have great diversity relative to their size, usually little more than half a hectare around the farmer's house. In one Javanese home garden 56 different species of useful plants were found, some for food, others as condiments and spices, some for medicine and others as feed for the livestock. Much is for household consumption, but some is bartered with neighbours and some is sold. The plants are grown in intricate relationships with one another in a dense planting resembling a miniature forest.

The diversity is in contrast to the adjacent, much simplified rice field systems where the only crop is rice, perhaps with some edible weeds and fish. Closer analysis shows the high diversity in the home garden is matched by high levels of productivity, stability, sustainability and equitability. A comparable rice field has higher gross income but otherwise its productivity is not as high and its other indicators are considerably lower.

Part of the reason for the minimal trade-off in the home garden is the inherent diversity. It helps stabilize production, buffers against shock and contributes to a more valued level of production. The intimate nature of the home garden enables close attention from family labour that ensures a high degree of stability and sustainability, and the link between the garden and the traditional culture leads to an equitable distribution of the diverse products.

This illustrates two points:

- the importance of maintaining and, wherever possible, enhancing diversity.
- the crucial role played by the farm household, in making decisions and choices.

In theory, households decide on livelihood goals - the balance between higher productivity, greater sustainability or improved equity - and then determine what the optimal mix of activities is. Most seek to obtain a high value of all of the properties and in this way achieve what we term a sustainable livelihood.

This depends on the skills and resources at the disposal of the household, and on their environmental and social circumstances. Since they are integral components of communities, they are bound by traditional customs and systems of rights and obligations. Yet their decisions are also determined by their perceptions of the present and future world in which they live, and by the opportunities which appear to be offered by new technologies.

What is the role of Science and Technology?

In most situations it is a combination of science and technology with economic and social factors that determines whether a livelihood is successful (i.e. sustainable) or not. For example, a farm livelihood will depend as much on efficient markets, both for the crop products and for the inputs as on the technologies behind the inputs – the crop varieties or the fertilizer formulations.

In productivity

Productivity of farm livelihoods depends very heavily on agricultural research and in particular on the breeding of crops to produce higher yields as in the Green Revolution. Today some improvements can be achieved by conventional plant breeding, but yields are increasing only very slowly and to make an impression we are increasingly dependent on biotechnology.

A recent example has been the crossing of Asian and African species of rice to produce the NERICAS – the new rices for Africa – using tissue culture. These hybrids are spreading in Africa producing yields of up to three tones per hectare without fertilizers. Marker-aided selection is also producing crops with greater value – for example the new maizes that have higher quality protein content. So far, genetic modification has contributed to productivity by reducing pest and disease attack. In China Bt cotton is being grown by many million households with higher yields and without the hazardous spraying of dangerous pesticides.

In stability

Stability is often a result of reducing the variability due to pest and disease attack. Integrated pest management that uses minimum amounts of selective and safe pesticides has had a highly beneficial effect on reducing annual pest attacks, for example of the brown plant hopper on rice in Asia.

Often instability is a function of the annual fluctuations in the rainfall. Technology can help here by providing irrigation systems, both on a large and small scale, and by breeding for a degree of drought tolerance. Recent work has helped uncover the location of drought tolerance in the main cereals and this is helping produce more drought tolerant crops using marker-aided selection.

In equitability

Increased equitability is often more a function of social and economic factors, but again science can play a role. Technology is equitable in its effect if it is appropriate i.e. it is practical, low risk and affordable for poor people. A good example is the treadle pump, being increasingly used in India. It is simple and efficient, easy to service and repair, and most important cheap. Combined with a simple credit scheme it is within reach of most of the poorest farmers. As such it can bring water into the hands of nearly everyone in a village and so enhances equitability.

In resilience

Resilience is becoming an increasingly important perceived property of livelihoods. Disasters ranging from earthquakes and tsunamis to hurricanes and cyclones and to the threat of avian flu can produce a major shock to the livelihoods of poorer people, driving them even further into poverty and often taking away their lives.

Disease is a major cause of shock in the developing world. Malaria, tuberculosis, HIV/AIDS and for children, various intestinal infections cause millions of deaths a year and impair the ability of rural people to make a decent livelihood. Here modern science and technology has much to offer through new medicines for malaria, TB and HIV/AIDS.

In general, effective resilience depends on counter-measures that can be classified as follows:

- Institutional – land use zoning, river management, warning systems
- Physical – cyclone shelters, embankments
- Environmental – mangrove belts, tree shelterbelts
- Agricultural – crop and livestock diversity, drought and flood resistant varieties