Bioresource flow modeling with farmers

Visualising the relation between farm enterprises and natural resource types enables farmers to explore new ways of recycling. But under which conditions does it economically make sense to recycle? A contribution from the Philippines.

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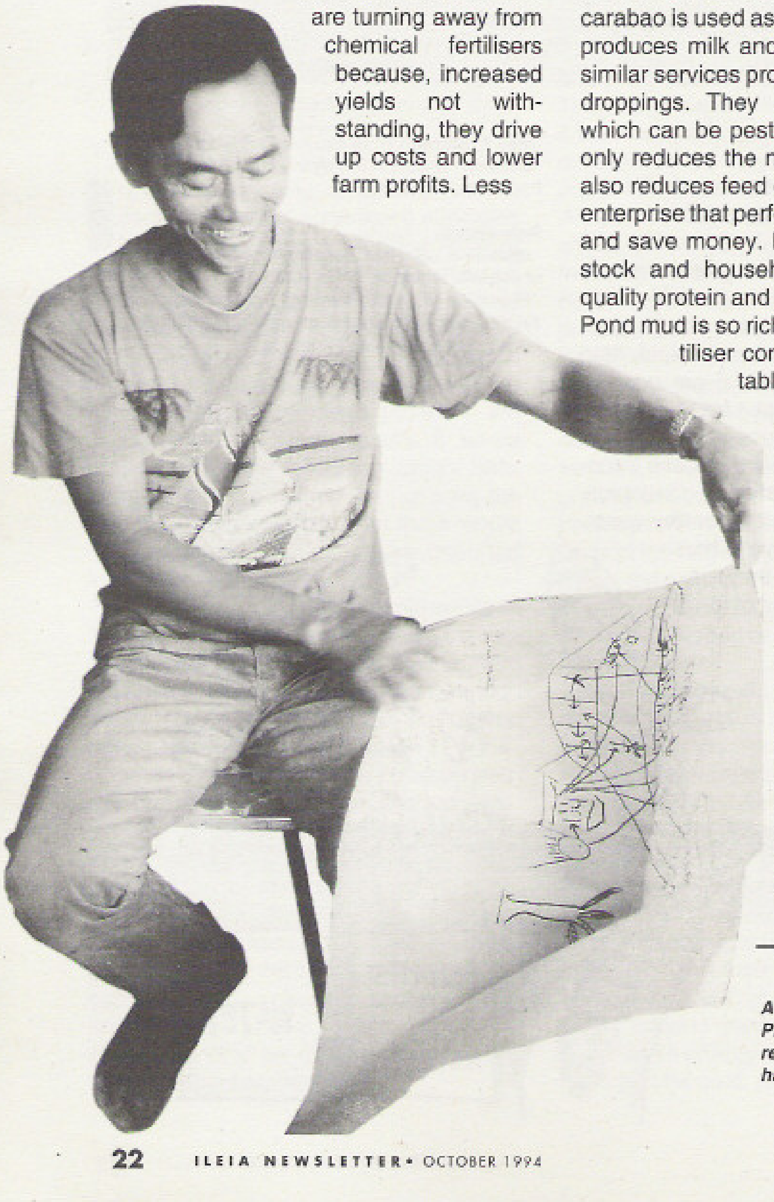
Recycling of biological resources, wastes and by-products can improve farm natural resources and incomes. A common observation among farmers is that soil fertility is improved when organic matter is returned to the soil. Farmers estimate that compost materials can replace basal applications of NPK to reduce fertiliser costs by up to 50%. More and more farmers are turning away from chemical fertilisers because, increased yields not withstanding, they drive up costs and lower farm profits. Less well-known farmer's knowledge is that pig manure stops seepage from ponds and that mud dredged up from ponds can considerably increase vegetable yields.

Indeed, when recycling flows are given cash values the gross incomes of farms increase dramatically. The value of all recycled materials can be up to 40% of gross farm income. Recycling is a bigger part of the farm economy than we might think. High value flows are often snails to feed fish, chickens and ducks, and rice grain to feed chickens. Lower value flows, though high in volume, are those for rice straw, which is utilised both as compost material and livestock feeds, and napier grass which is used as feed for cows, carabao and goats.



A farmer in Cavite, Philippines, looks at the bioresource flow diagram he has just accomplished.

Recycling enterprises

There are some enterprises that are particularly good at promoting recycling. For example, a carabao eats grass and crop residues and produces manure for organic fertiliser to the crops. Moreover, the carabao is used as a draft animal and also produces milk and meat. Ducks perform similar services producing eggs, meat and droppings. They also eat some snails which can be pests in ricefields. This not only reduces the need for pesticides, but also reduces feed costs. Fish are another enterprise that perform ecological services and save money. Fish convert crop, livestock and household wastes into high quality protein and nutrient rich pond mud. Pond mud is so rich that it can replace fertiliser completely in small vegetable gardens.

Taken together the direct and indirect effects of recycling can have significant impacts on the ecological sustainabilty of the entire farming system. Indirect effects include the integration of new enterprises that promote recycling as well as the rehabilitation of natural resources that either result from recycling or are necessary to enterprise integration. For example, a farm had six enterprises and two flows before integration. These increased to 11 enterprises and six flows upon integration. The newly introduced fish pond opened opportunities for the culture of fish and water spinach using on-farm inputs. Existing by-products are used to a greater extent. These low-value flows led to the production of high-value products. Diversification and integration brought about an increase in net income from US$ 350 to US$ 750 and biomass production from 7 to 8 tons/ha.

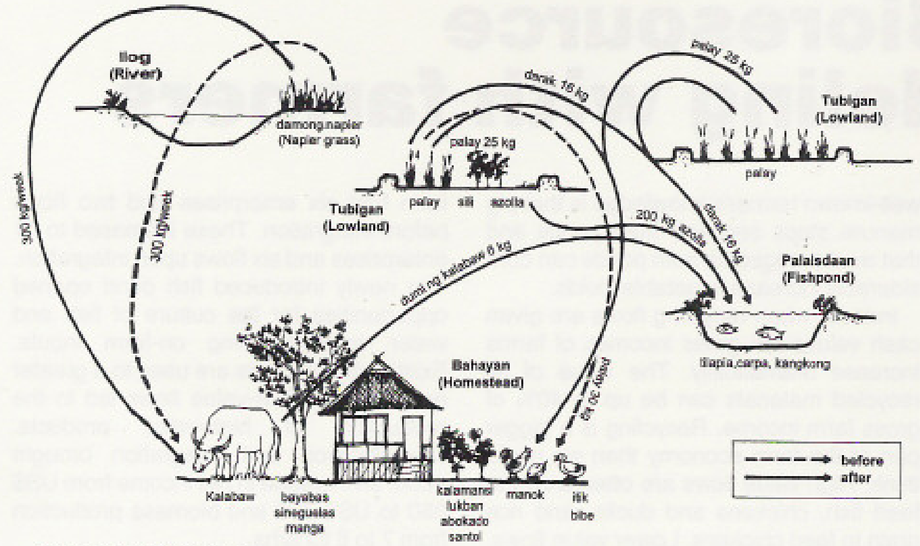
Bioresource flow models

The dramatic results described were initiated by farmer-researcher discussions over farmer-drawn bioresource flow models (BRFM) of their existing farming systems. The bioresource flow model shown is a picture of the natural resource types, drawn as topographical cross-sections of land and water resources. The enterprises conducted on them are drawn as icons and the farm generated by-products and wastes that flow from one enterprise to another are drawn as arrows. Manure to crops, rice-bran to pigs, and tree leaves to goats are typical examples of bioresource flows. Recycling does not include product (grain) flows to market or to household consumption except where household wastes, i.e. kitchen waste, cooking ash and night soil are recycled. Likewise, external inputs to fields like inorganic fertiliser are not included. These flows are omitted because they do not depict recycling. Bioresource flows can be expressed in several "currencies", like biomass, nitrogen, energy and cash. We have found biomass to be the most useful when discussing recycling with farmers.

Discussing new flows

These models provide a vehicle for farmers and researchers to exchange technical ideas about how new flows and new enterprises can be integrated into ongoing farming systems and how degraded natural resources might be rehabilitated. Farmers learn how different enterprises and natural resource types support and regenerate each other and how cash is saved when by-products are used to substitute external inputs. They draw the new flows and enterprises on their bioresource flow models thus creating a "future" farm model. The farmers use these diagrams to guide their exploration of new activities and linkages. The impacts shown occurred because farmers were supported by research and extension.

Farmer-scientist discussions over bioresource flow models not only result in farm-



Before and after integration:
Bioresource flows between natural resources, Phillippines

ers learning new ways to recycle materials, but also inform the extension services, both government and non-government, what kinds of inputs farmers need to develop ecologically sustainable farming systems. Similarly, researchers learn what new experiments are needed from them.

BRFM puts a demand on research and extension from the farmer. This is the strength of the models, they help people learn about recycling. They do, however, have weaknesses. During discussions, farmers often ask how they should split up their meagre supplies of manure among enterprises. BRFM cannot provide a complete answer. Farmers can be helped visiting other farmers' plots or experiment station plots. It is, however, very difficult to generate the conversion coefficients for many wastes, particularly manures and composts, because they are so variable. This difficulty is increased by problems in trying to evaluate bioresources that do not have a market value. Somehow, using costs of labour involved in making the transfers, or using equivalent costs of chemical fertilisers underestimates the true value of these materials and all the services they offer.

Who can benefit

Given the benefits that can be achieved by recycling far fewer farmers recycle than could. Farmers give a wide range of reasons why they or their neighbours do not recycle. Cultural taboos may inhibit the handling of manures. Manure for fertiliser may compete with other domestic uses for manure, such as for fuel. Lack of access and tenure can keep people who need nutrients out of the recycling option. Not being able to grow fodder trees or graze animals on the "commons" are typical examples. Some farmers do not recycle because it is not part of their farming tradition. Other farmers do not recycle because it is not seen as modern or progressive farming. But, perhaps the most common reason given for not recycling materials like manure is that buying inputs is quicker than recycling, which is time-consuming and labour demanding. Simply, the returns are either too uncertain or too modest. Clearly, in many cases, recycling is not going to happen without help: from education and supportive agricultural policies. In the examples given, farmers learned much from each other and from researchers during the BRFM exercises.

Many of the new flows that emerged were made possible by integrating key enterprises into their farming systems. Fish and many other animals act as bioconverters of wastes on the farm. Enterprises that can turn low quality plant residues and by-products into feeds and fertilisers for other enterprises are vital. Fertilisers will still be needed, but to supplement organic materials rather than replace them. In some cases this will not be enough to provide satisfactory returns to the high labour inputs required. As long as chemical fertiliser is cheap and organically grown food is not subsidised, it makes little economic sense to recycle. Perhaps the most important challenge facing those concerned with the ecological sustainability of agriculture is to demonstrate that policies to "level the playing field" are needed. ■

How to undertake BRFM

Bioresource flow models are constructed using participatory rural appraisal (PRA) techniques. This means that appropriate steps have been taken to ensure that you are talking to members of your target group and that all members of the research team are in listening mode. This is the time to elicit the household's knowledge. Prior to the PRA described here researchers must have identified the indigenous categories of natural resource types. These are the land and water resource types often found in agroecosystem transects.

While the example here describes a process with one household, the process works for groups as well. The PRA starts with a walk around the farm. During the walk: a) reaffirm the natural resource type categories; b) identify as many enterprises as possible, not forgetting to include off season enterprises, and c) remark on obvious evidence of flows, ie presence of a compost pit. On returning to the household explain to the household that there is too much going on for you to remember and ask them to recall what has been seen. Have the farmer indicate on the ground or on a large sheet of paper the natural resource types visited. Help them to draw topographical cross-sections of each one. Remember that it is important to hand over the drawing instrument to the farmer as soon as possible.

Included in the drawings are those natural resource types beyond the farm that they access. Special attention is needed to ensure that common property resources are not left out of the picture. Once all the cross-sections are completed, ask them to draw an icon to represent each enterprise conducted on the natural resource types. Lastly, the farmers draw arrows between enterprises and natural resource types to show flows of farm-generated biological materials, e.g. cow manure from the cow shed used as a feed/fertiliser input into the fishpond. The arrows are completed with name and amount of material and the frequency of the flow. Quantities are given in local terms and units such as bucketful's or bundles or conventional units according to individual preferences. A detailed description of this method has been published in ILEIA Newsletter (Ofori et al. 1993, Lightfoot and Tuan 1990).

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