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Summaries

Food-for-work for poverty reduction and the promotion of sustainable land use: can it work?

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Recent research on food-for-work (FFW) programs has focused on their short-term impacts in terms of poverty targeting efficacy and protection against shocks. While these issues are important, there has been a tendency to neglect the more long-term effects of FFW in terms of poverty reduction, growth enhancement, and natural resource conservation. Most hunger in the world is due to chronic deprivation and vulnerability, not short-term shocks. Furthermore, many FFW programs have explicit long-term objectives as primary or equally important objectives. This paper therefore assesses the potential of FFW to contribute to poverty reduction and natural resource conservation in the longer run. We do this through analysis of survey evidence from northern Ethiopia that we use to motivate a simple theoretical model, a less general and more detailed version of which we then implement through an applied bio-economic model calibrated to northern Ethiopia. The analysis explores how FFW project outcomes may depend on FFW project design, market conditions, and technology characteristics. We show that FFW programs may either crowd out or crowd in private investments and highlight factors that condition whether FFW promotes or undercuts sustainable land use.

Our empirical evidence from northern Ethiopia shows that time constraints and food supplied through FFW may crowd out other activities and own food production. However, we also found that FFW projects could crowd in private investment in soil and water conservation by providing technical support, mobilizing local labor, coordinating activities across farms, resolving resource conflicts, and possibly providing insurance and reducing personal discount rates.

We then illustrate the possible crowding-out effects through a simple static household model with imperfect markets. A straightforward dynamic extension of the model illustrates the possible crowding-in effects through investment-stock effects related to the natural and human resources controlled by households.

Finally, we illustrate the inherent ambiguity of FFW projects' effects on long-term productivity and natural resource conservation through a

bio-economic household model applied to an area in northern Ethiopia. This dynamic, non-linear, non-separable household model simultaneously integrates economic optimization in production and consumption with intertemporal environmental feedbacks. Several different scenarios are compared. First, FFW employment directed outside agriculture can be compared against FFW applied within agriculture in form of investment in land conservation. We show how assumptions about access to alternative off-farm employment (i.e., the opportunity cost of farmers' time) and the short-term impacts of conservation technologies on farm productivity affect outcomes of FFW interventions. The simulations show that FFW targeted outside agriculture may reduce incentives for agricultural production and land conservation and therefore have negative crowding-out effects. However, if FFW is targeted at investment in land conservation, FFW may enhance agricultural production in the longer run and lead to more sustainable production. The conservation effects of FFW may be higher when the private incentives for conservation are lower.

We conclude that FFW projects have the potential of contributing to long-term development in economies characterized by imperfect markets but poor design and implementation can easily lead to the opposite result. Effective design and implementation of FFW programs to yield long-term, sustainable gains in low-income, rural communities demands great skill and knowledge from implementing agencies.

Incorporating systems dynamics and spatial heterogeneity in integrated assessment of agricultural production systems

JOHN M. ANTLE and JETSE J. STOORVOGEL

Agricultural systems are complex and dynamic, being made up of interacting bio-physical and human sub-systems. Moreover, agricultural systems are remarkably diverse, both within geographic regions and across regions. Accordingly, this paper focuses on dynamics and heterogeneity in coupled, multi-disciplinary simulation models of agricultural systems. In the first part of this paper, we discuss issues associated with combining disciplinary models to construct a model of an agricultural system, and the ability of these coupled models to represent the dynamic and spatial properties of agricultural production systems. We then discuss how we have implemented a modular, 'loosely coupled' approach to modeling production systems. We discuss our use of this approach, and its limitations, to study the sustainability of the potato-pasture system in Ecuador. This modeling system incorporates dynamic disciplinary models and spatial heterogeneity, but does not incorporate systems dynamics in the form of

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feedbacks between disciplinary processes. Next we discuss how the loosely coupled modeling approach can be modified to incorporate feedbacks among sub-models, and how it can be extended to include a closer coupling of disciplinary models when sub-processes in the models interact dynamically. Finally, we use our case study of the potato-pasture system to illustrate the application of these concepts and their relevance in this case study.

While agricultural system models are often used independently to assess impacts of policy and technology changes on the systems, one of the important goals of this line of research is eventually to be able to couple an agricultural system model with models of other bio-physical and human processes in rural areas. For this purpose, the modeling approach we have described can be extended in several directions. The model we have presented is an agricultural system model of the individual farm production decision maker. This model does not include other household decision-making processes, such as the labor supply, food consumption, or healthcare decisions of the household. While it is clearly possible to extend the style of model presented here to be incorporated into a household production approach, we noted that doing so may greatly increase data requirements and model complexity. The modeling approach we have presented here is based on the paradigm of an individual, price-taking farm firm. An important challenge is to incorporate this kind of agricultural production system model into a model of market equilibrium. While economists have developed many equilibrium models, those models abstract from the issues of system dynamics and spatial heterogeneity that we have shown are an important part of agricultural systems. The concepts discussed in this paper should prove useful in developing methods for coupling agricultural system models to broader models of household behavior and to market equilibrium models that do incorporate important aspects of system dynamics and spatial heterogeneity.

Externalities and labour market linkages in a dynamic two-sector model of tropical agriculture

GERALD E. SHIVELY

High erosion rates are widely associated with agricultural production on steeply sloping land. In the case of erosion externalities, land and labour allocation decisions made on upland farms influence erosion rates and, via sedimentation, the productivity of downstream lowland agricultural systems. This paper uses a simulation model to study the connections between erosion damages generated by a land-intensive upstream farm and labour hiring on a labour-intensive downstream farm. The paper

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highlights the potential role of payments to upland workers as a mechanism to influence the evolution of the two agricultural systems over time.

Two representative farms are examined. An upland farm uses labour to produce an agricultural product and, as a byproduct, an externality. A lowland farm, which is also a potential employer of upland labour, is adversely affected by this externality. In structure, the model is broadly reflective of a complete, but simple, watershed economy characterized by both biophysical and economic feedbacks. Parameters for the model are based on observed patterns of upland-lowland agricultural production in a Philippine watershed. The model produces a range of development trajectories. Along one set of paths, externalities reinforce incentives to engage in externality-producing activities. These perpetuate poverty and accelerate downward trends in incomes and environmental quality. Along alternative paths, externality avoidance generates a self-reinforcing incentive that pulls labour away from the externality-producing activity. This slows the rate of decline in lowland labour productivity and also helps to moderate (but not reverse) the downward trends in income and environmental quality.

Simulation results reveal an important and seemingly paradoxical policy implication of the model, namely that, in a dynamic setting, efficiency criteria may justify interventions aimed at redistributing agricultural surplus from those who are affected by an externality to those responsible for generating the externality. The study demonstrates how both upland and lowland incomes decline over time due to erosion damages. But when the upland and lowland farms are connected through erosion and the labour market, environmental payments made by the lowland farm to workers from the upland farm can produce income gains for both upland *and* lowland households. This can occur if the payments are tied to drawing labour out of production of the erosive activity and thereby increasing productivity in the wage-paying sector. An important implication of considering the connection between economic and environmental dynamics is that policies to redistribute productivity gains from lowland to upland farms may be supported on efficiency grounds.

An application of the use of safe minimum standards in the conservation of livestock biodiversity

ADAM G. DRUCKER

This paper adapts the safe minimum standard (SMS) approach so as to explore its use as a potential policy decision support tool that can be applied

to issues related to the conservation and sustainable use of farm animal genetic resource (AnGR) diversity.

The basic framework considers that the uncertain benefits of indigenous livestock breed conservation can be maintained, as long as a minimum viable population (the SMS) of the breed is also maintained. The costs of implementing an SMS are made up of the opportunity cost differential of maintaining the indigenous breed rather than an exotic or crossbreed. In addition, the administrative and technical support costs of the conservation programme also need to be accounted for. However, as the absolute number of indigenous breed animals that needs to be maintained for an SMS to function is relatively small, the cost of doing so is hypothesised to be relatively low. Conceptually, the costs of implementing a safe minimum standard are established by comparing three policy scenarios. These include maintenance of the indigenous breed, complete breed substitution, and partial substitution while maintaining an SMS.

Having shown how the SMS, as originally conceived, can be adapted to consider livestock biodiversity, empirical cost estimates are then obtained using data from three AnGR economics case studies in Mexico and Italy. The findings support our hypothesis that the costs of implementing an SMS are low, both when compared with the size of subsidies currently being provided to the livestock sector (<1 per cent of the total subsidy) and with regard to the benefits of conservation (benefit–cost ratio of > 2.9).

We conclude that the SMS approach could support AnGR conservation decisions but that much more extensive quantification of the components required to determine SMS costs needs to be undertaken before it can be applied in practice. Such economic valuation needs to cover both the full range of breeds/species being considered, as well as to ensure that as many as possible of the elements making up their total economic value are accounted for.

Bio-economic development of floodplains: farming versus fishing in Bangladesh

MURSALEENA ISLAM and JOHN B. BRADEN

This paper explores economic development in the floodplain of large rivers. For many developing countries, rivers are central to economic development, supporting agriculture, transportation, commerce, and fisheries. In this paper, we show that both economic and ecological factors need to be considered for effective management of rivers where the floodplain is a resource for fisheries as well as agriculture. Our focus is

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on floodplain management in Bangladesh, where policies over several decades have emphasized structural changes to enhance agricultural production. However, these structural changes reduce fisheries production, an important natural resource sector and a source of subsistence nutrition for the rural poor. We develop a model where net returns to agriculture and fisheries are jointly considered, taking into account the effect of flooding depth and timing on production of both crops and fish and the nutritional as well as market value of fish. We apply the model to data for the Tangail region, an area of 143,640 hectares in the Brahmaputra River floodplain of North-Central Bangladesh. Our results show that management that accounts for fisheries benefits as well as agricultural benefits, essentially forgoing embankments in favor of natural floodplain function, yields higher overall economic returns compared with a floodplain modified by flood control structures. This finding implies that neglecting the bio-economic relationship between fisheries and land use may diminish the long-run economic role of a river floodplain, particularly in a poor country. The increased significance of our results for poor countries is because of the severe natural resource and land constraints in these countries and the extreme dependence of the rural poor on such resources.

Collective action in community management of grazing lands: the case of the highlands of northern Ethiopia

SAMUEL BENIN and JOHN PENDER

Common grazing lands are important sources of livestock feed in developing countries, although unrestricted access to such resources can result in overexploitation and degradation of the resource. Alternative ways of managing common resources, including state, collective, and private management, have been suggested to arrest resource degradation.

Collective action, where regulations and restrictions are imposed on using the resources, is increasingly recognized as a viable and promising method of managing natural resources, and the literature on explaining community investment in institution building in natural resource management is very well developed. However, it is not clear why there are often violations of restrictions in equilibrium. First, a theoretical framework that explicitly models individual violations behaviour is presented. Then, data from the highlands of Amhara region of Ethiopia are used to test the predictions of the theoretical model to examine the impact of policy-relevant

factors on establishing restricted grazing areas and violating grazing restrictions.

The data show that slightly more than one-half of the communities had at least one restricted grazing area, where grazing was restricted to certain times of the year only, to certain types of livestock only, or a combination of the two. Although no positive monitoring costs were incurred, except in a few cases where paid guards were employed, penalties were established for violating grazing restrictions. Violations were reported in nearly one-fifth of the restricted grazing areas.

Econometric results suggest that collective action in grazing land management is likely to be more successful and effective in communities with better market access (associated with greater livestock profitability) or higher population. However, collective action is less likely to be successful in communities with greater social, economic, or cultural heterogeneity or more affluent members, as the diversity increases heterogeneity in the probability of detecting violators or the difficulty of members in reaching an agreement on grazing restrictions that is mutually beneficial.

Some factors may have opposing effects. For example, higher rainfall (also associated with greater livestock profitability) and larger total land area (associated with fixed costs of negotiating agreements) were associated with greater likelihood of having a restricted grazing area as well as greater likelihood of violating grazing restrictions.