Environment and Development Economics 11: 411–415 © 2006 Cambridge University Press
doi:10.1017/S1355770X06003019 Printed in the United Kingdom

Summaries

Implications of agricultural policy for species invasion in shifting cultivation systems

HEIDI J. ALBERS, MICHAEL J. GOLDBACH,
and DANIEL T. KAFFINE

Integrated economic-ecological systems such as shifting cultivation rely on the ability of the underlying natural systems to support economic production despite the stresses that economic activities impose. This paper develops a dynamic optimization model of farmer decisions in a shifting cultivation system that contains a critical threshold for recuperative potential. Crossing this threshold results in an irreversible regime change where forest and soil fertility cannot recover and a grass regime dominates. If policies induce farmers to use young fallows or to crop for extended periods, the system's capacity to regenerate becomes depleted enough for invasive grasses to take hold and reduce both the ecological and economic output of the system.

Numerical solutions to this problem provide a basis for analyzing the decisions of farmers who are informed about the ecological setting and of farmers who are uninformed about the potential for ecological regime change. In all cases, the policies considered improve the welfare of the informed farmer, but can create different outcomes for the ecologically myopic farmer. The analysis demonstrates that policies to supplement soil fertility can increase the chance of grass species invasion for both types of farmers. Policies that reduce production costs, provide input subsidies, or create output price supports can improve the welfare of the ecologically informed farmer, but they can also decrease the welfare of the ecologically myopic farmer by leading that farmer to inadvertently cause the ecological regime change. Policies that improve productivity, reduce startup costs, or encourage forest recovery increase the welfare of both farmers, while augmenting the ability of the system to withstand the threat of invasive grasses.

The bioeconomics of controlling an African rodent pest species

ANDERS SKONHOFT, HERWIG LEIRS, HARRY P. ANDREASSEN, LOTH S.A. MULUNGU, and NILS CHR. STENSETH

The paper treats the economy of controlling an African pest rodent, the multimammate rat, causing major damage in maize production. An ecological population model is presented and used as a basis for the economic analyses carried out at the village level using data from Tanzania. The control problem is specified as timing and duration strategies where the dosage of the poison is kept fixed per month whenever poison is used (consistent with recent practice in Tanzania). The most cost-effective control period seems to be just before the planting season. The damage at planting accounts for such a large portion of the total losses due to rodents, that minimizing the population during that short period is enough to reduce yield losses. Controlling for a longer period will reduce rodent populations at a time when they do not damage the crop anyhow, and, due to the very high reproductive capacity of the rodents, the population will increase rapidly as soon as control operations are stopped, repressing any long-term effects. A combination of control just before the planting season, January and February, combined with a month control towards the end of the previous year in October or November, seems to be the best overall strategy. These economically most rewarding strategies differ significantly from today's practice of symptomatic treatment when heavy rodent damage is noticed. The paper demonstrates that shifting from such practices to more mechanistic control strategies; that is, emphasizing the calendar instead of the pest abundance, can substantially improve the economic conditions for the maize producing farmers in the present case of multimammate rats. The best practices compared with today's symptomatic treatment could typically reduce the production costs by half.

Multiple equilibria, soil conservation investments and the resilience of agricultural systems

JOHN M. ANTLE, JETSE J. STOORVOGEL, and ROBERTO O. VALDIVIA

This paper provides a new explanation for the persistent land degradation in some parts of the world, despite investments in development of soil

https://doi.org/10.1017/S1355770X06003019 Published online by Cambridge University Press

conservation technologies and projects to encourage their adoption. We demonstrate that soil conservation technologies may induce agricultural systems to exhibit equilibria characterized by both low and high levels of soil degradation. These two equilibria are separated by a threshold level of soil degradation beyond which a conservation investment will not yield a positive return. Once a parcel of land crosses this productivity threshold, soil degradation becomes economically irreversible (it is not profitable to invest in soil conservation), even though the degradation may be technically reversible. A case study of terracing investments in Peru is used to demonstrate the existence of multiple equilibria under conditions typical of many marginal agricultural areas. The case study shows that 25–30 per cent of fields exhibit multiple equilibria under a wide range of conditions.

The possibility of economically irreversible soil degradation has significant implications for the resilience of agricultural systems and for the design of policies aiming to prevent degradation or restore lost productivity. First, there may be a high cost to prevention of economically irreversible degradation, and poor farmers and poor societies may be unwilling or unable to pay this cost. Second, once economically irreversible degradation has occurred, subsidies for adoption of soil conservation practices are unlikely to lead to permanent adoption by farmers. A key policy question is how long successful incentives must be provided for permanent adoption of restorative practices on highly degraded soils. Generally, the more severely degraded land is, and the slower is the rate of recovery, the longer external incentives will be needed to successfully restore the system to the high-productivity equilibrium.

Pollution thresholds under uncertainty

FRANZ WIRL

The related concepts of resilience and sustainability are often criticized as vague and are therefore considered in this paper as the search for a threshold. Yet even with respect to thresholds at least two different approaches exist. One approach derives a threshold from maximizing the net present value of benefit streams from an environmental resource (e.g. the widely studied shallow lake problem) and the other is the real option approach pioneered by Dixit and Pindyck which emphasizes underlying uncertainty and irreversibility. More precisely, this paper investigates how much stress one should allow on an environmental resource (clean air, water, etc.) serving as a 'money pump'. Indeed, Murray Feshbach (University of Georgetown) suggested the transgressions of such thresholds in the Soviet-Union ('more than 70 million people were exposed to pollutants that exceed at least five times the official limits for pollution,

https://doi.org/10.1017/S1355770X06003019 Published online by Cambridge University Press

and more than 43 million people are exposed to pollution that is 15 times the official limits for pollution') were responsible for the ultimate collapse of Communism. On the other hand, Larry Summer wondered (when at the World Bank) why poor countries do not exchange their clean and under-polluted environment for dollars to foster development.

This study investigates the optimal use of 'dirty' technologies for economic development and when to stop polluting, either temporarily or forever. This question is addressed within a real option framework where three different kinds of options arise: for stopping pollution temporarily or forever and for re-starting. The possibility to shelve a polluting technology temporarily allows for a more conservationist policy. Irreversible stopping – scrapping a technology for all the future – is rational only at very high pollution stocks, i.e. the domain of keeping but not using a polluting technology is large. And, indeed, discussions about a restart of 'polluting' after a period of banning is observable in particular in developing countries, e.g. the cases of the elephant and DDT (for malaria prevention in Africa). The costs associated with such a re-start lead to hystereses effects, such that the policy does not only depend on the current state of the system (the stock of pollution), but also on the history, in the sense of whether polluting is "on" or "off". This makes cross-country comparisons about the efficiency of national (or regional) pollution strategies difficult.

Fragmented landholding, productivity and resilience management

NIRMAL SENGUPTA

The operation of a number of non-contiguous parcels of land as a single farming unit is known as land fragmentation. It is a widespread and persistent phenomenon. Although governments and development agencies have always worked towards consolidation of land, available evidence clearly suggests that unqualified faith in the merit of consolidation is not justified. Fragmentation may have some rationale. After summarizing the positive opinions, this paper undertakes an intensive study of fragmentation in an irrigated agricultural system of India. The case study shows that fragmentation is not merely an accident of arbitrary inheritance; it results after considerable land transactions and conforms to certain regularities that increase both equity and productivity of the irrigation system. In addition, the study locates fragmentation within the broader context. It is not an isolated phenomenon. Analysis of its interface with other activities in the local economy would show the true role of fragmentation. In the case study area the local economic and ecological system is crucially dependent on farmers' participation for operations and management of the irrigation system. At the same time, numerous natural and social

uncertainties, from variations in rainfall to political conflicts, lead to varying rates of participation. Operations and management of the irrigation system fail if enough farmers do not participate in the tasks. Repeated failures of this nature may ultimately result in decay of the irrigation system and subsequent decline of the local economy. By using a mathematical model, the present study shows that fragmentation contributes towards increasing participation and sustainability of the system against such risks. It also shows that the complex rules of fragmentation are one of the many devices that farmers create to secure community participation. Fragmentation is one of the many expressions of farmers' creative participation. This leads the author to make a recommendation. If an existing state of participation is adjudged desirable, development agencies should let farmers adapt to the situation and encourage their participation to flourish in its own way. Consolidation against farmers' will would not be an appropriate strategy. There are other areas where agencies can meaningfully contribute.

Firm size diversity, functional richness and resilience

AHJOND S. GARMESTANI, CRAIG R. ALLEN, JOHN D. MITTELSTAEDT, CRAIG A. STOW, and WILLIAM A. WARD

The purpose of this paper is to apply recent advances in ecology to our understanding of firm development, sustainability, and economic development. A rich literature exists on the effects of geography and firm characteristics on the development of firms in an economy. Less is known about the role that industrial diversity – within and between types of industries – has on the success of firms, industries, or communities. This is an important issue for development economics, because economies are concerned with the resilience of firms in the aggregate. The concept of resilience provides a means to understand inter- and intra-industry effects on the sustainability of industries, as a whole. The ecological literature indicates that the greater the functional richness of species in a system, the greater its resilience – that is, its ability to persist in the face of substantial changes in the environment. This paper focuses on the effects of functional richness across firm size on the ability of industries to sustain themselves in the face of economic change. The findings of this paper offer direction for policy aimed at sustainable economic development.