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# Policies for sustainable land management in the highlands of Ethiopia

Summary of papers and proceedings of a seminar held  
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# Agricultural change and land management in the highlands of Tigray: Causes and implications

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This study investigates changes in agriculture and land management practices between 1991 and 1998 in the highlands of Tigray, northern Ethiopia, and the causes and implications of these changes, based upon a community-level survey conducted in 100 villages in 50 *tabias*.

Since 1991, a broad process of development has been occurring in Tigray, involving substantial investments in roads, irrigation and other infrastructure and improved access to education, health care, water, agricultural extension and other public services. These investments and services have resulted in improvements in many aspects of life in Tigray, reflected in the relatively upbeat responses that survey respondents provided to most of our questions about changes in welfare. The improvement in access to infrastructure and services has been greatest in areas that were less favoured in 1991, helping to equalise access across the region, though improvement is still needed in most areas.

In addition to public investments and services, farmers have undertaken a substantial amount of private and community investment, including accumulating livestock assets (especially oxen), planting trees (both privately and in community woodlots) and investing in various soil and water conservation structures. They have also adopted more labour and capital-intensive agricultural management practices. These private investments have contributed to improvements in resource conditions, most of which were also perceived by farmers to be improving in general.

We have investigated the determinants of changes in agricultural and land management practices and their implications for productivity, resource conditions and human welfare, and have identified a number of important tentative findings (subject to verification through analysis of ongoing household- and plot-level surveys in the region). The agricultural extension programme appears to have effectively promoted more intensive land management and conservation practices, contributing to higher crop yields, and increased wealth and access to food. However, it also appears to have contributed to worsening grazing land conditions. The Tigray Bureau of Agriculture and Natural Resources Development (BoANRD) should investigate this problem further and consider options to intensify and improve management of grazing lands.

Irrigation was found to be an important factor underlying different livelihood strategies, favouring production of perishable cash crops as well as non-farm activities as sources of cash income rather than ruminant production. Irrigation has contributed to intensified land use and to changes in crop choice but has been associated with less adoption of fertilisers and improved seeds, and less improvement in yields than ex-

pected. As a result, it appears that the returns to modern irrigation investment so far have been relatively low. This issue should be of high priority for further study, given the large amount of resources that are being invested in this development and options should be considered to improve the returns to irrigation investment in Tigray. These options may include increasing the priority of extension activities in irrigated areas and increasing the emphasis on promotion of high-value crops in such areas. Complementary investments in roads or other infrastructure may also be important in some areas.

Road development appears to have contributed to shifts in production away from livestock (especially cows) towards greater production of some cash crops. Road development is not as strongly associated with adoption of purchased inputs as we expected but has contributed to changes in some agricultural practices, particularly reduced burning to prepare fields. This may be an important reason why yield improvement for barley and maize has been greater in areas with better road access, since burning is associated with declining yields. Road improvements are associated with increased food availability, improvement in the quality of grazing land (probably as a result of reduced emphasis on livestock production), and improved availability and quality of water. Overall, road development has contributed to agricultural development and improved resource management and human welfare.

Population pressure was found to increase several indicators of the labour and capital intensity of agriculture. However, this intensification did not result in significantly increased yields, suggesting that land degradation caused by population pressure is reducing cropland productivity. The quality of grazing land is also being degraded by population (and associated livestock) pressure. Despite these negative indications, differences in measures of human welfare were generally unrelated to population pressure and in some instances population pressure was associated with improved conditions. This is likely due to greater investments in infrastructure or public services in areas with greater population pressure, suggesting the importance of such investments in maintaining and improving welfare in the region despite high population pressure.

Educational improvements appear to have contributed to several aspects of agricultural intensification and technology adoption, including use of fertilisers and vaccines, and adoption of some intensive land management practices such as composting, planting trees and live fences. Despite this, there is a puzzling association between education and declines in soil fertility and yields of some crops. This may be related to the fact that fallowing is declining more rapidly in areas where farmers are more educated. This suggests the importance of teaching principles of sustainable land management in school curricula. Aside from this negative association of education with soil fertility, the impacts of education on many other natural resource conditions (e.g. the quality of grazing land, forest and water) are positive and large. Education is also strongly associated with reductions in infant mortality. Thus the overall benefits of improved education for resource management and human welfare appear to be quite substantial.

Differences in livelihood strategies have also led to important differences in land management and in productivity, resource conditions and human welfare. Areas where non-farm employment is important have performed better than other areas in several

respects, including improvement in crop yields, food availability, reduced erosion, and improved availability and quality of water. Promotion of non-farm development thus appears to offer potential as a more productive and sustainable development pathway for the region. Realisation of this potential appears to depend upon agricultural development, however, given the strong association of this strategy with irrigation investment. Development of cash crops, including perishable annual crops and perennials, is strongly associated with irrigation investment and also helps to reduce pressure on grazing land and cropland erosion. In many areas, however, the potential for development of cash crops or non-farm activities is low. Livestock will continue to be critical to the development strategy of these areas. A critical issue for these areas will be to increase the productivity and sustainability of grazing land management.

Overall, development in Tigray since 1991 has been impressive and conditions are generally improving. Nevertheless, important problems and challenges remain. It is hoped that this study will help policy makers to identify some key areas to focus on, in order to continue to achieve broadly shared and sustainable development in the region.