2.11 Conclusions

Improved Dairy Technology has had a positive effect on the Kenyan economy and social welfare. Further positive impacts are possible under a full adoption scenario, although the bulk of the benefits have already been achieved, based on current population demand. Future improvement in dairy production will most likely go to meet the growing demand. With the adoption of the Improved Dairy technologies, total social welfare increased an additional 705 million Ksh annually. These results indicate that the Improved Dairy technologies have substantially benefited producers and their families through expanded supplies and lower prices for milk and other commodities and through reduced milk imports. The results also indicate that when the Improved Dairy technologies are fully adopted, consumers and national economic welfare would be further increased, but farmers and their families would realize only modest gains in their economic benefits. Reductions in the returns to land and labor resources would be nearly equal additional savings in home consumption expenditures for rural people.

When the dairy technology improvements are fully adopted under demand growth rates associated only with rising population for the next 15 years, as contrasted to current adoption rates and demand levels, both consumers and producers benefit. Regional consumers in towns and cities nationally gain 181.54 billion Ksh (113.2%) annually, while home consumption expenditure by farmers and their families is increased 58.3 billion Ksh (107.0%) annually. Producers return to land and labor are increased 11.8 billion Ksh each year. The increase in home consumption expenditure for food substantially outweighs the increase in producer’s return to land and labor. Foreign surplus increases only slightly, up 274 million Ksh annually, or about 0.3%. Total social welfare in Kenya is increased 135.31 billion Ksh (67.0%) annually under the demand growth scenario. Increased production and consumption of milk accounts for near one-third of the increase in welfare of regional consumers in towns and cities, and about 72% of the increase in home consumption expenditures of farmers and their families. These results indicate that even under demand growth conditions, domestic consumers in towns and cities are likely to be the major beneficiaries of the smallholder dairy research and technology transfer relative to rural producers and their families that adopt the new technologies and increase the available domestic supply of milk.

Results from the deterministic and stochastic simulations of the representative farms indicate that the horticulture, peri-urban and coast farms generally benefited most from the adoption of the improved dairy technologies. NPV, net cash farm income, and RNW are positive and increase as the dairy technologies are adopted on these farms under deterministic conditions. When price and yield variabilities are taken into account, only the coast farm and the horticulture farm experienced slight increases in NPV, net cash farm income, and RNW from adoption of the improved dairy technologies. Other farms exhibit a mixed pattern of income and net worth mean values as a result of the dairy technologies.

The impact of smallholder dairy technologies has been environmentally neutral when averaged across administrative districts. However, the evolution of these technologies from traditional zebu dairying on common grazing lands to the current mix of farms and technologies has resulted in an increased streamflow of approximately 23% while sediment loading has risen by 5% using the Sondu River basin as a point of reference in the Highlands of Kenya.

Point based sampling and subsequent derivation of agro-ecological zones that represent different types of dairying environments offered a robust method to establish a spatial sampling frame for the biophysical
simulations. These spatially explicit biophysical simulations allowed us to address both the issue of eco-
nomic and environmental impact across administrative zones and agro-ecological zones using the same
simulations. Using area-weight responses of biophysical crop/forage yield responses and animal nutritional
responses provided spatially coherent average yields for the sector model. Using the representative farms, it
was possible to aggregate point based simulation data across sub-basins to derive spatially explicit river
basin level responses. Feedback from land use change predicted by the ASM model allowed a direct
linkage to the environmental modeling work via the ACT tool and spatial sampling frame established in the
beginning of the case study.

The limited availability of well distributed weather data and limited soil information presented a challenge to
the effort that was overcome by application of data approximation techniques. Such tools as soil parameter
estimators, land demand algorithms, weather generators and satellite weather data play a critical role in
supporting the biophysical models and ultimately parameterization of the economic models. The use of the
spatial sampling frame allowed identification of areas where representative farms should be selected and
determination of areas of “geographical equivalence” that comprised the agro-ecological zones established
for the smallholder dairy production systems.

Careful selection of the representative farms and economic analysis of those farms generally provided results
at the household level that were consistent with the aggregate macro-level impacts as revealed by the ASM
results for Kenya. The suite of tools when used in the proper sequence proved to be less than perfect but
robust enough to be linked in a spatially coherent manner and applied in a manner to allow systems feed-
back between the economic models and the environmental models and yield valued information for policy
decision makers.