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THE GROWING PLACE OF LIVESTOCK PRODUCTS IN WORLD FOOD IN THE TWENTY-FIRST CENTURY**

by

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***This paper is a summary of Livestock to 2020: The Next Food Revolution, a forthcoming 40,000 word report in the 2020 Vision Initiative Food, Agriculture and the Environment discussion paper series of the International Food Policy Research Institute (IFPRI). The longer report was produced jointly by IFPRI, the Food and Agricultural Organization of the United Nations (FAO), and the International Livestock Research Institute (ILRI), under the same authorship. It gives the detailed references for the data and citations drawn upon. Delgado and Rosegrant are Research Fellows at the International Food Policy Research Institute (IFPRI), Washington, D.C.; Steinfeld is Senior Officer, Livestock Development Planning, Food and Agricultural Organization of the United Nations (FAO), Rome; Ehui is Leader of the Livestock Policy Program, International Livestock Research Institute (ILRI), Addis Ababa; Courbois is Research Analyst at IFPRI, Washington, D.C.*

MSSD Discussion Papers contain preliminary material and research results, and are circulated prior to a full peer review in order to stimulate discussion and critical comment. It is expected that most Discussion Papers will eventually be published in some other form, and that their content may also be revised.

A revolution is occurring in global agriculture with profound implications for human health, livelihoods, and the environment. The less than one-quarter of the world's population living in the developed countries presently consume an average of three times the meat and five times the milk per capita as people in developing countries. Yet, it is in developing countries where massive annual increases in the aggregate consumption of animal products are occurring. From the beginning of the 1970s to the mid 1990s, consumption of meat in developing countries increased by 70 million metric tons, a volume more than twice as large as the increase in developed countries, and two-thirds as large as the increase in consumption of cereals in developing countries that is known as the "Green Revolution" (Table 1). The market value of the additional meat consumed in the developing countries surpassed the market value of the increased cereals consumed under the Green Revolution by a factor of three. The forces that drove that increase are expected to continue well into the new millennium, creating a veritable Animal Food Products Revolution (AFPR) with important benefits and risks to consider.

The AFPR is propelled by people in developing countries increasing their consumption of animal products from the very low levels of the past. Aggregate consumption grows fastest in countries where population is growing rapidly, where diets are changing with an increasingly urban population, and where high income growth enables more people to add variety to their diets. As

shown in Figure 1, per capita meat consumption is highly correlated with national per capita income.

These forces drove meat and milk consumption to grow at 5 and 3 percent per year respectively throughout the developing world since the early 1980s. Countries in East and Southeast Asia where income grew at 4-8 percent per year, population at 2-3 percent per year, and urbanization at 4-6 percent per year had meat consumption growth of between 4 and 8 percent per year.

Whether these trends will continue into the future is a question explored with IFPRI's International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT), a global food model first reported in Rosegrant, Agcaolili-Sombilla, and Perez (1995). The IMPACT model details the interrelationships among the supply and demand for both livestock and feed over time. Starting with exogenously specified trends in national incomes for 37 country groups in the world, it then traces food demand, feed demand, and supply levels for 18 commodities, iterating to market-clearing prices for major commodities annually through 2020.

The baseline, or "most likely," IMPACT projection is that developing country growth rates for aggregate consumption of meat and milk over the 1992/94 to 2020 period will be 2.8 and 3.3 percent per annum respectively, compared to 0.6 and 0.2 percent in the developed countries. Aggregate meat consumption in developing countries will grow by nearly 100 MMT between the

early 1990s and 2020, whereas the corresponding figures for developed countries is 16 MMT (see Figure 2). Similarly, additional milk consumption in the developed countries of 13 MMT of Liquid Milk Equivalents (LME) will be dwarfed by the additional consumption in developing countries of 227 MMT. As Figure 2 suggests, the experience will vary widely among different parts of the developing world, with China leading the way on meat with a doubling of the total quantity consumed. India and the other South Asian countries will drive a large increase in total milk consumption.

Production patterns closely follow consumption patterns, with shortfalls made up primarily by increased feed imports. By 2020, people living in developing countries are projected to produce on average 38 percent more meat and 54 more milk per capita than in the early 1990s (see Figure 3). Much of the expansion in meat production is of monogastric livestock, such as pigs and poultry. Production of products such as pork, poultry, eggs, and milk creates heavy demand on high-energy feed such as cereals. IMPACT projects a worldwide expansion of an additional 292 MMT of cereals used as feed per annum by 2020 (see Table 2).

There is a corresponding increase in the shares of the developing countries in the world's production of meat and milk. Those shares were only 31 and 25 percent, respectively, in the early 1980s. The baseline projections are that in 2020 developing countries will produce 60 percent of world meat and 52

percent of world milk. Clearly the brunt of the benefits and costs expected from the AFPR will accrue to the developing countries.

Even with these large increases in animal food product consumption and cereals use as feed, inflation adjusted prices of livestock and feed commodities are expected to fall (Figure 4), though not as rapidly as they have during the past twenty years. Maize prices are projected to fall the least, reflecting high demand for the commodity as feed.

Sensitivity analysis is used to test the effect on projections of changing assumptions. Adjusting the IMPACT model to reflect a prolonged and severe economic crisis in Asia, the growth of aggregate consumption of livestock products remains strong in developing countries, though consumption growth in Asia is lower and prices fall further than in the baseline projection (Figure 4). The model also shows that a dramatic shift in tastes in India toward meat consumption would have the opposite effect, raising projected world prices.

Simulations testing the impact of changes in the efficiency of grain conversion to meat or milk show that efficiency and cost matter greatly to the competitiveness of individual producers, to the use of cereals as feed, and to world trade patterns, but barely affect world livestock consumption. Under the extreme assumption of a 60 percent rise in the amount of feed projected to be required to produce a unit of meat and milk in developing countries in 2020,

world maize prices are only 21 percent higher than the baseline projection. In real terms, that level is still half the prevailing prices in the early 1980s.

These projections are confirmed by events in world markets over the past 25 years. Demand increases for meat and milk have largely been met through expansion of feed production or imports at world prices that have declined in real terms. Historically, livestock has been one of the main factors stabilizing world cereal supply. Evidence from years of cereal price shocks in the 1970s and 1980s suggests that reductions in cereal supply were largely absorbed by reductions in feeding to livestock.

The key insights that come out of the modeling exercise are, first, that the forces driving increasing consumption of animal products, population, income growth, and urbanization, are robust and unlikely to diminish in the next twenty years, and second, that with even modestly increasing productivity, supply of meat, milk, and feed is forthcoming without dramatic price increases. Key issues then are not whether sufficient animal products and cereals will be available, but what impact increased production and consumption will have on the environment, human health, and the incomes of the poor.

The impact of the AFPR on the environment is potentially worrisome. The impacts of demand increases on production around the world are conditioned by diverging opportunity costs of factors used in livestock production, and by transfer costs. The result is increasing intensification of production in places

where financial capital is cheap relative to land (such as Holland) and degradation of extensive production resources in places where land is "free" (such as most of the African Sahel).

The past rapid expansion of livestock food production in developing countries was primarily from increased numbers of animals rather than higher carcass weight per input unit. This has contributed to large concentrations of animals and people in urban environments in many cities of developing countries where the regulatory framework governing livestock production is weak (such as in Beijing, Mumbai, Lima, and Addis Ababa). It has also led to degradation of rural grazing areas in many cases, and the clearing of forest. Growing concentrations of animals and people in the major cities of developing countries also lead to rapid increases in the incidence of zoonotic disease, such as Salmonella, E-coli, and Avian Flu, which can only be dealt with through enforcement of zoning and health regulations.

Public health issues raised by the AFPR are of major importance. Greater intensification of livestock production is leading in many places of both the developed and developing world to a build-up of pesticides and antibiotics in the food chain through livestock production practices. Furthermore, as the consumption of livestock products increases in tropical climates, food safety risks from microbial contamination become more prevalent.

On the consumption side, there is concern that increased animal products consumption is unhealthy. However, there is little evidence that for the foreseeable future increased consumption of meat and milk would be harmful for the majority of people in developing countries. On the contrary, protein and micro-nutrient deficiencies, which tend to disappear with increased consumption of livestock products, remain widespread in developing countries. The exception would be among the relatively wealthy in urban areas of fast growing countries, where per capita consumption of livestock products is rising rapidly to levels approaching those in developed countries.

Another concern is that increased use of feed to produce animal products for the relatively rich will cause upward pressure on prices of cereals, the staple food of the world's poor. While it is true that feeding cereals and soybeans to animals typically directly creates fewer calories and less protein than it absorbs, the idea that reduced demand for feed would overcome the complex income, infrastructure, and food distribution problems that result in calorie malnutrition is an unrealistic oversimplification of the problem.

Far from being a drain on the food purchasing power of the poor, increased consumption of animal products can be a major element in increasing the incomes of the poor on the production side. There is considerable evidence from in-depth field studies of rural household income generation strategies in Africa and Asia that shows that the rural poor and landless presently get a

higher share of their income from livestock than better off rural people (Table 3). The exception tends to be in Latin America, where relative rural wealth correlates more clearly with cattle holdings. In most of the developing world, a goat, a pig, some chickens, or a milking cow can provide a key income supplement for the landless and otherwise asset-poor.

However, there is a danger that rapid industrialization of production could harm this major mechanism of income generation for the poor. There are large economies of scale in processing livestock-origin food products, but relatively few in production beyond a fairly low threshold in most cases. It is therefore critical for poverty policy to seek vertical integration of small producers with livestock food processors, through contract farming or participatory producer coops. The alternative might be that the poor are driven out by industrial livestock producers and the one growing market they presently compete in will be closed to them.

Policy is not very good at changing consumption patterns in developing countries, given the structural nature of the changes driving the nutritional transformation (income growth, urbanization, and population growth). However, policy is critical to determining the costs and impacts of livestock production, whether the extra products are produced at home or abroad, and whether they are produced by smallholders or by large industrial enterprises.

Livestock products presently contribute about 40 percent of the value of food and agricultural production in the world, but receive a disproportionately small allocation of public investments for facilitating production. Educational, veterinary, research, extension, and specialized input provision are not yet fully privatized in developing countries and probably will not be for some time to come at prevailing levels of development. Incorporating smallholders into this increasingly commercialized business will require public action to support participatory farmer technical and marketing organizations.

Inappropriate livestock development patterns such as high cost and highly capitalized industrial pig, milk, and poultry production in the peri-urban areas of developing countries are often the effect of distortions in domestic capital markets. These policies distort the pattern of livestock development and ultimately are not sustainable. Urban piggeries and dairies that cannot adequately dispose of waste materials are often the result of poor regulatory environments, distortions in the marketing chain that prevent competition from rural areas, and lack of legal accountability of economic agents for pollution.

Over-grazing is often the result of inadequate property rights development or enforcement mechanisms, or politically motivated subsidies to large producers. Policy needs both to focus on the overt distortions that produce problems, but also on how to let financial incentives to producers and consumers

better match the full costs and benefits inherent in livestock production, a sector well-known for its many non-market externalities.

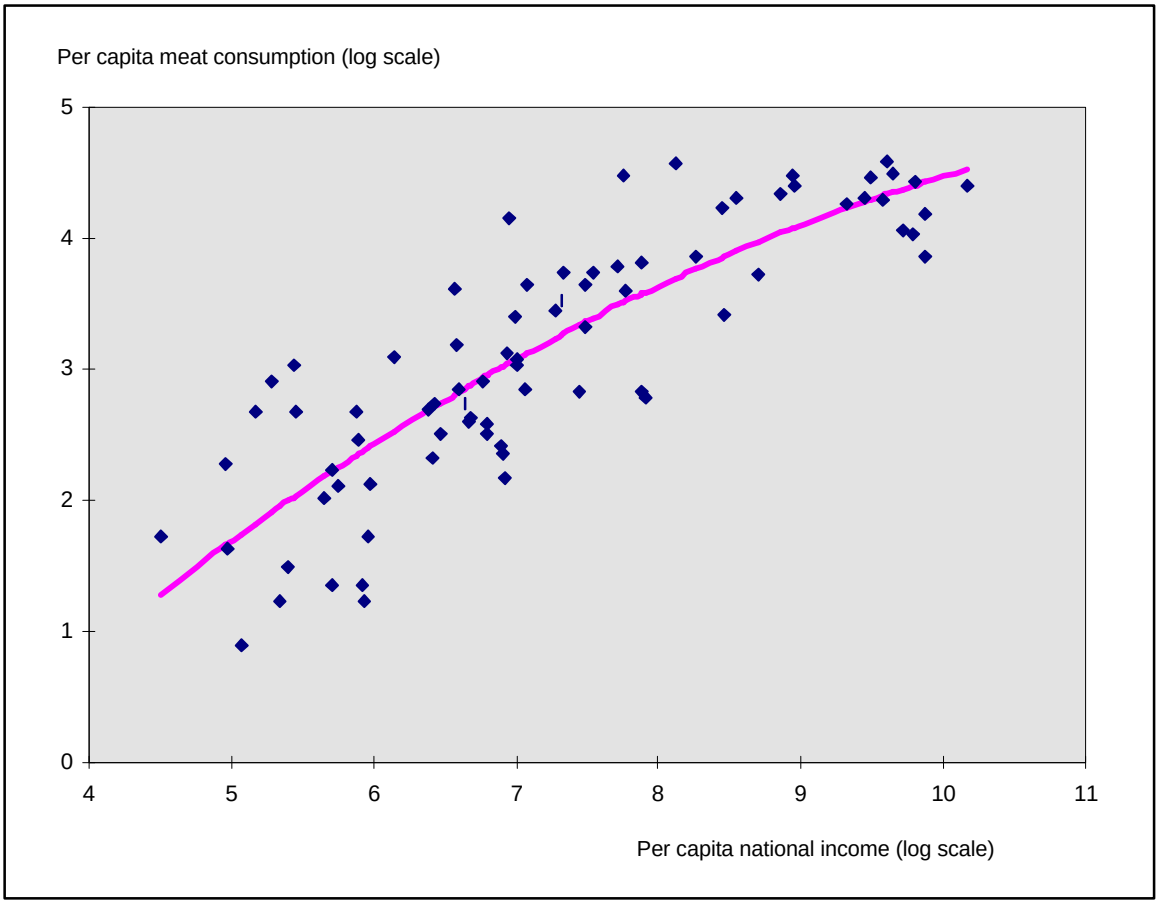
Governments and development partners seeking entry points to facilitate the participation of the poor in commercially viable activities need to follow the AFPR closely. The stakes are high, and the probability of success is enhanced by rapidly growing demand for output. The worst thing that well-motivated agencies can do is to cease public investments that facilitate economic, sustainable, and small-operator oriented forms of market-oriented livestock production. Lack of action will not stop the AFPR, but it will help ensure that the form it takes is less favorable for growth, poverty alleviation, and sustainability in the developing countries.

Table 1–Food consumption increases for meat, milk, and major cereals 1971-1995[a]

Commodity	Consumption Increase		Value of Consumption Increase[b]		Caloric Value of Consumption Increase	
	Developed	Developing	Developed	Developing	Developed	Developing
	(million MT)		(billion US$)		(trillion K-calories)	
Meat[c]	26	70	37	124	38	172
Milk	50	105	14	29	22	64
Major cereals[d]	25	335	3	65	82	1,064

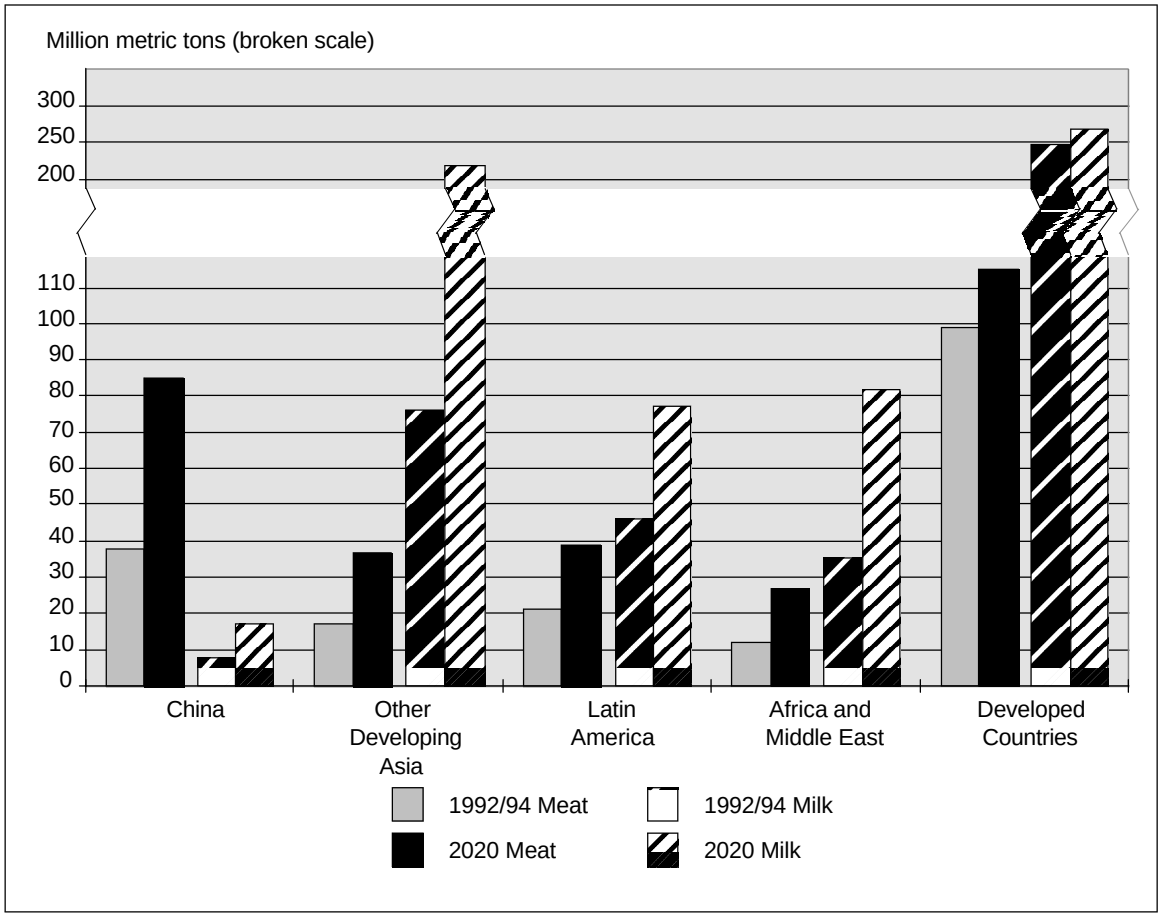
Notes: [a]Aggregate changes between three year averages centered on the years shown.
[b]Using 1990 average world prices expressed in constant 1990/92 US$.
[c]Beef, sheep/goat meat, pork, and poultry.
[d]Wheat, rice, and maize used directly as human food.

Figure 1–The relationship between meat consumption and wealth



Note: Each dot is an observation for 1 of 64 countries examined. The solid line is a statistically significant trend.

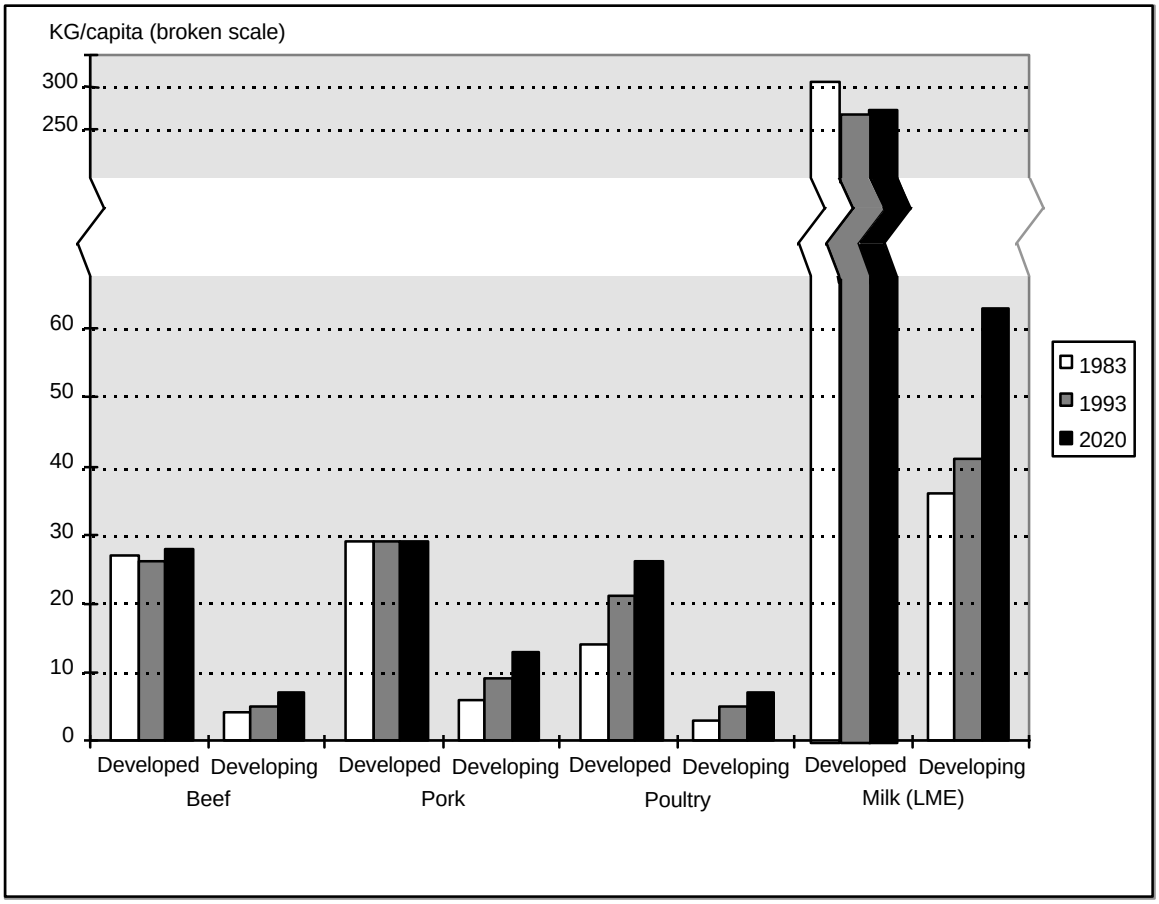
Figure 2–Actual and projected annual consumption of meat and milk by region



Sources: FAO Stat 1999 and IMPACT projections.

Note: [a]The China figure for meat in 1992/94 is almost certainly too high, with revisions down to 30 million MT likely very shortly. This does not change the interpretation in any significant manner.

Figure 3–Per capita annual production of selected animal products in developed and developing countries



Sources: FAO Stat 1999 and IFPRI's IMPACT model.

Table 2–Actual and projected trends in the annual use of cereal as feed

Region	Projected Annual Growth Rate of Cereal Use as Feed 1992/94-2020	Total Cereal Use as Feed	
		1992/94	2020
	(percent per year)	(million MT)	
Developing	2.8	194	409
Of which China	3.4	73	178
Developed	0.6	442	519
World	1.4	636	928

Sources: FAO Stat 1999.
Notes: Cereals includes wheat, maize, rice, barley, sorghum, millet, rye, and oats.

Figure 4–Indices of projected 2020 inflation-adjusted prices under different scenarios (1992/4 actual prices = 100)

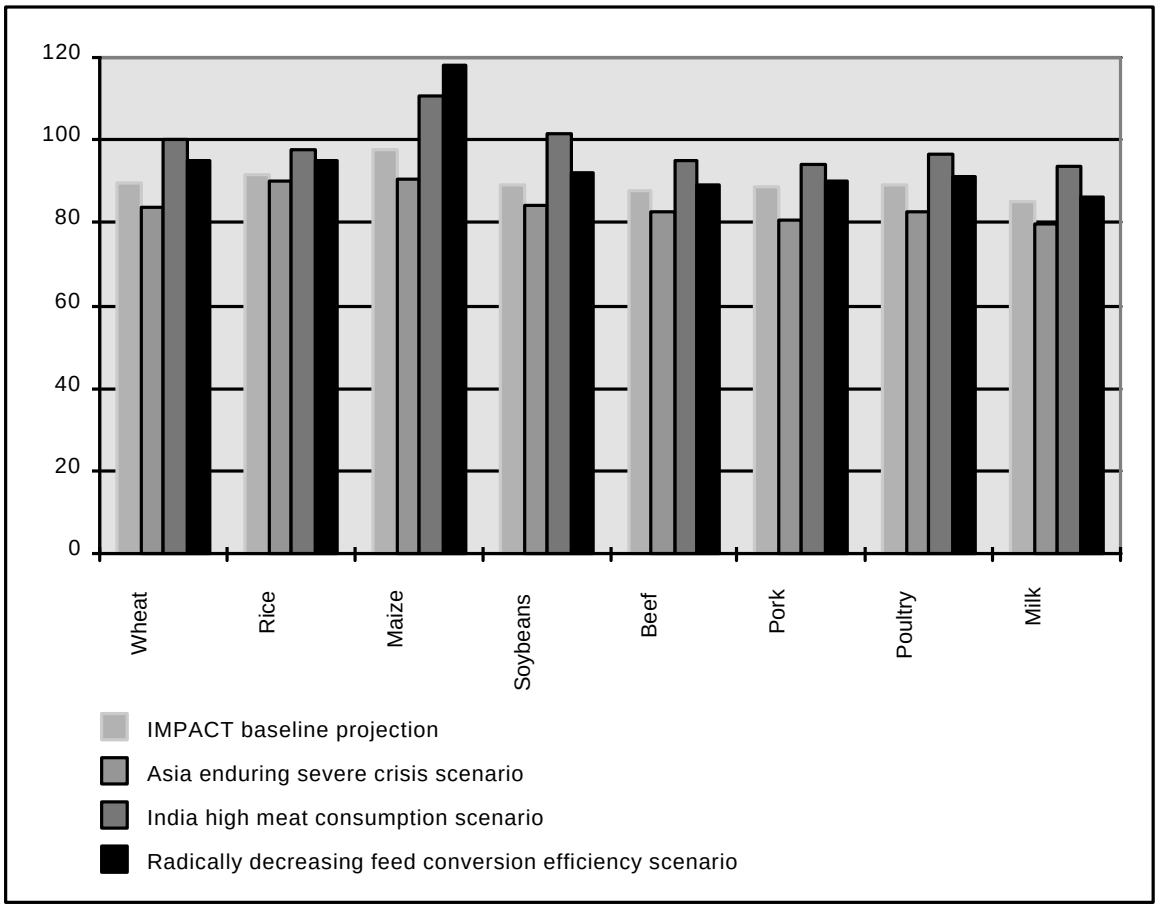


Table 3–The role of livestock in the income generation of the rich and the poor

Case	Wealth/Poverty Stratum	Percent of Household Income From Livestock	Type of Data
Senegal[a]	Lowest 1/3	24	1988-90, 29 rural households
	Highest 1/3	14	
Philippines[b]	Lowest 1/5	23	1984-85, 500 rural households
	Highest 1/5	10	
Pakistan[c]	Lowest 1/5	25	1986-89, 727 rural households
	Highest 1/5	9	
Sudan[d]	Lowest 1/5	14	1989, 240 households
	Highest 1/5	13	
Kenya[e]	Lowest 1/5	61	1998, 310 dairy farmers
	Highest 1/5	38	
Brazil[f]	Lowest 1/5	37	1994, 154 rural households
	Highest 1/5	64	

Sources: [a]Kelly, V., T. Reardon, A. A. Fall, B. Diagana, and L. McNeilly. 1993. *Consumption and supply impacts of agricultural price policies in the peanut basin of Senegal oriental*. Unpublished report. Washington, DC: International Food Policy Research Institute.
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Further Readings

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