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Agricultural Industrialization and Sustainable Development: A Global Perspective

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Abstract

Agricultural industrialization and sustainable development issues are important contemporary areas of debate. This paper argues that the two processes are a consequence of a set of forces operating in our global system. It outlines a number of conceptual interactions between the two phenomena and examines economic development and sustainable development policy implications that appear to be logical extensions of the arguments presented.

Key Words: agricultural industrialization, sustainable agricultural development, development assistance, human capital, market and policy failures, public policy.

Issues relating to agricultural industrialization and sustainable development have emerged as important contemporary areas of debate within and outside of the agricultural professions, at both national and international levels. These issues are likely to receive increasing attention by agricultural economists and other agriculture and natural resource related professions, well into the twenty-first century. The concept of agricultural industrialization as a nomenclature describing significant structural changes in the food and fiber system (domestic and international) is of relatively recent vintage, as is that of sustainable development. While these terminologies are "newcomers" to the literature and the debates, it should be recognized that the elements of the processes that they describe and the forces behind the processes, are by no means new. What might be new, however, is the increasing attention being given to the public policy concerns emanating from the processes as we approach the twenty-first century (Barkema, Drabenstott and Cook; Henderson and Handy; van Ravenswaay; Batie; Castle, Berrens and Polasky).

Briefly stated, agricultural industrialization refers to "the increasing consolidation of farms and to vertical coordination (contracting and integration) among the stages of the food and fiber system" (Council on Food, Agriculture and Resource Economics, 1994a, p.1). Sustainable agricultural development is one dimension of the general concept of sustainable development. Sustainable development as a concept, means different things to different disciplines (Cernea; Munasinghe; Rees; Serageldin; Steer and Lutz). The concept is grounded in the initial ideas of the World Commission on Environment and Development (1987) which suggested the Biospheric World View, but has evolved through various stages to relate specifically to agriculture (Food and Agriculture Organization/Technical Advisory Committee (1989). We define sustainable agricultural development in

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this paper as an agricultural system which over the long run, enhances environmental quality and the resource base on which agriculture depends, provides for basic human food and fiber needs, is economically viable, and enhances the quality of life of farmers and society as a whole (Office of International Studies and Programs).

The agricultural industrialization and agricultural sustainability processes and their associated policy concerns are being fueled by a common set of complex changes, including, among other things: (1) increased consumer demands (2) institutional restructuring in the food and fiber system (3) new production and information technologies (4) increased efficiency goals (5) concerns about risk management and (6) increased financial requirements in the food and fiber system. Increasing returns to scale is a fundamental force behind the processes. Denison (1974) and others working on productivity have estimated that about one-third of the gains in productivity in the United States come from increases in scale. Increases in productivity are also clearly recognized as an important factor in increasing ones comparative advantage. Perhaps our commercial farm firms are ahead of us professional economists in recognizing the importance of these issues for their own economic survival and are moving to position themselves in the increasingly open world-trading environment in which they find themselves. A major problem for us economists is that economies of scale moves us away from a competitive model and the conceptual basis with which we are comfortable, and into the realm of imperfect competition, and the situation where our premises lead to no well defined saddle-point (Krugman). This dilemma is well captured in the observation that this trend has spawned a situation in which, "The traditional reliance on price adjustments to signal changes in supply and demand conditions for commodities has been reduced " (Council on Food, Agriculture and Resource Economics, 1994b, p. 8).

We note, and think that it is not inconsequential from a policy perspective, that the requirements for sustainable agricultural development also moves us away from the competitive model. These requirements reorder the criteria for valuing human-welfare gains by measuring and incorporating environmental elements in contrast to strictly economic accounting criteria such as GNP and GDP. This is a fundamental shift away from our orthodox ways of measuring developmental progress. This shift is well articulated in the statement, "the ecosystem contains the economy to which it supplies a throughput of matter-energy taken from *in natura* uses according to some rule of sustainable yield rather than according to individual willingness to pay" (Daly, p. 187). If the imperatives of agricultural industrialization and sustainability are moving the policy formulation process away from orthodox competitive economic equilibrium solutions, there are also indications that significant counter-flows are at work in the global arena. Some of the more important counter-flows are: (1) privatization as an engine of growth (2) trade liberalization under the GATT and (3) consolidation of capital and product trade flows into mega-trading blocks.

This paper seeks to contribute to the dialogue regarding the interactions between the agricultural industrialization phenomenon, and the emerging sustainability requirement that growth (scale) in food and fiber production must be accomplished in environmentally benign ways. The paper is primarily conceptual, since research efforts on links between agricultural industrialization and environmental integrity are in their nescient stages. The first section presents a discussion regarding what we consider to be some of the key elements underlying the processes and forces shaping them. The second section examines specific global economic developmental trends as defined by the relationships between the North and the South, particularly as these relationships are affected by the agricultural industrialization/sustainable development nexus. The third section examines implications for sustainable development policies and strategies that appear to be logical extension of the forces discussed in preceding sections. Section four presents some brief concluding remarks on the issues discussed.

Forces Behind the Processes

If agricultural industrialization and the realization of agricultural sustainability are a consequence of a set of similar forces operating on our global system, "What are these forces?" In this section we speculate and suggest at least a subset of

them. In doing so we implicitly assume that the forces are exogenous to the system in which size of firms and the degree of concern for and impetus relating to sustainability are endogenous and moving more or less together. We think the system tends toward a recursive structure. However, we hasten to point out that our knowledge about this structure is conjectural. Furthermore, we point out that knowing whether a variable is endogenous or exogenous is very important to the policy-making process.[1]

More Open Markets and Increasing Trade

During the past two decades capital markets have become very open and efficient among countries with tradable currencies. Recent developments with NAFTA and GATT suggest a growing international recognition of the potential of gains from trade. This greater openness creates an environment of increasing concern about a country's comparative advantage, or in the longer term and the popular business language of the day, "competitiveness". A more open system where products are traded more freely also encourages greater economic efficiency in the use of the world's resources for a given level of production.

Greater Concentration of Consumers and Proximity Spillovers

As the world-wide migration of people from the rural areas to the mega cities and lesser metropolitan areas continues there is a greater centralization of markets. These markets encourage bigness in both the sources of supply and in transportation and methods of distribution--especially for tradables. This migration also relieves relative pressures on the natural resource base in rural areas--especially those areas which use slash-and-burn and other traditional techniques of production. Admittedly, this trend seems offensive to those who see the small subsistence farmer as a way of life and a thing of beauty. However, the rural poor view migration as an opportunity and it offers one of the few ways they have available to increase their expected economic well-being (Papanek and Kuntjoro-Jakti). The degree of urbanization of a population also is a known factor in lowering fertility rates. Migration does create real metropolitan hot spots in the environment, but as our earth becomes more crowded it also permits economies in assembling and processing wastes. There are also scale effects in delivering health services--especially clean water and educational assistance programs for better nutrition and family planning.

Greater Use of Purchased Inputs

The industrialization of agriculture is encouraged by quantity discounts and bulk purchases of inputs. Large firms have a distinct advantage in the input market both because of their increased bargaining power and the lower per unit cost of packaging and transporting inputs in large quantities[2]. The by-passing of the local dealer reduces the number of middlemen. Even when large purchases are made through a local dealer, the movement of the input materials is often direct from the source to the user.

Transportation

The average per unit cost of moving agricultural inputs and outputs is a declining function of volume in a time frame which permits changes in the methods of handling and the type of carrier used. Considerable amounts of grain in the midwestern region of the United States are moved directly from the farm to a river or lake terminal with perhaps only the transaction being made through a local elevator. Also, farmers with large quantities generally have less difficulty scheduling with truckers. As such, economies of size in transportation occur from physical handling and moving and also in paper work and other fixed costs of transactions.

Technology Versus Space

A well-known phenomenon is that developed countries (the so-called North) have found it easier to increase production by increasing yields than by increasing the area cultivated, while developing countries (the so-called South) depend more on increased area cultivated. Agriculture has a history of using too little capital and too much labor (Johnson, 1994b). This becomes less true with increased levels of economic development. The willingness of small farmers in less-developed countries to use more labor per hectare of land and hence drive down their marginal productivity of labor has often been used to argue that small

farmers are more efficient producers. This is true only in terms of the partial productivity of land. It is not true in a multi-factor sense of productivity. As countries develop economically, labor markets converge as do the capital markets and less labor and more capital are used in agriculture. This trend leads to a greater use of technology and the result that it is easier to make gains in production with increased yields versus increased area. Those who use technology well will crowd out those who do not and agricultural firms will grow in size. From the agricultural sustainability perspective this trend can be positive because it means that we can get our daily bread with less land. In the long-term and assuming that increased population does not overwhelm the development process, agriculture in a privatized and open system will concentrate on the most productive lands from a global perspective. This trend will help preserve the more environmentally sensitive lands that are marginal for agricultural production.

Gains from Labor Specialization

There is some specialization of labor on family farms, much as occurs in households. Task responsibilities have a way of being partitioned so that individuals know what is expected of them. With movement toward larger firms (domestically and internationally), there are greater opportunities to further specialize tasks and to capture gains from specialization as per the old truth from Adam Smith. For example, in the United States some of the large hog operations which are currently evolving have training courses for specialization in specific tasks. Contracts for production also lead to a partitioning of tasks and greater specialization.

Economies of Scale in Doing Business

With increased population congestion and new knowledge creation, producers in all sectors will move toward a more highly technical and regulated decision environment. In such an environment there will be ever increasing opportunities for the specialization of such tasks as tracking business and having a paper trail, sourcing and managing new information, meeting operational and reporting requirements of environmental regulation, following food safety standards, assuring contracts specifications are met, and being responsible for personnel requirements, and other legal mandates. There are great economies of scale in handling such matters. A small farmer will simply be overwhelmed by this myriad of tasks and skills that a more regulated decision environment will place on him or her. New firms specializing in the provision of such services for a fee will come into being but again there are economies with the larger accounts. Externally mandated requirements in regulating such things as the environment for sustainability, health and food safety, and personnel will lead toward both increased industrialization and sustainability objectives in agriculture.

There seems to be little doubt that we are moving globally toward greater sensitivity to our natural capital stock and the sustainability of it for life and lives in future generations. These concerns will undoubtedly translate into greater efforts to both regulate and monitor how environmental and natural resources are used. We would argue that such increased regulation if enforced, will encourage larger firms in agriculture for at least two important reasons. First, the private cost of learning about regulations and how to satisfy them is fixed. A large firm can spread this cost over more units of production. Secondly, the public cost of educating, monitoring, and policing firms' behavior will be less with fewer of them.

Intellectual Property Rights and Research

The possibilities of capturing rents from intellectual property rights is encouraging more research in the private sector both on the product and input sides of markets faced by agricultural firms. Increased interest in agricultural sustainability and the environment may also lead to increased quest for rents from new methods of managing and treating potential pollutants and reducing resource depletion. There is also a marked increased in joint public/private research activity with arrangements for sharing royalties. At least in the United States privately funded research in the agricultural sector is growing faster than publicly supported research, and provisions to protect intellectual property rights in GATT should support the quest in a broader global framework. Also, many multi-national firms are large on the supply side of agricultural markets and are positioned to capture some gains as both producers and users of new technologies. This force may be of relatively minor importance in the industrialization of

agriculture but it is not neutral and again points to economies of scale.

Lower Cost of Capital

An important reason why capital has been historically under used in agriculture has been its inability to compete against manufacturing and other non-farm sectors. In large part, this is due to the transaction costs in making and servicing small loans to small farmers. With the current international trend toward privatization and openness, these forces again encourage larger farms--especially since governments seem to be increasingly unable or unwilling to subsidize this input.

Risk Management

Increased size can provide a firm with greater opportunities to manage risks both in terms of its portfolio of activities and its ability to access information and capital. For example, the owner of a large privately held rice farm in Guyana, South America, also runs a large rice mill, markets rice internationally, and has non-farm activities. Sixty percent of the rice entering the mill is purchased from smaller rice producers. The firm is not as completely dependent on its rice production for its income as are the small farmers who depend almost solely on their rice crop. In the United States, a large hog operation which farrows, feeds, slaughters, and markets boxed meat is not dependent solely on those activities found on the typical hog farm. Whether the lower risk associated with this vertical integration can offset the added risk of disease remains to be seen.

Organization of Agricultural Firms

Related to the element of risk management is the need for organizational changes at the firm level in agriculture. Our image of small farmers buying inputs from local merchants and selling their products in local markets is close to our favored competitive model in economics. Today, this model is most applicable to small traditional farmers producing for and selling in local food markets and there are many of them in all parts of the world--especially in the developing countries. However, this model is most applicable to situations where decisions are made predominantly on near-term price signals without explicit concern for sustainability objectives. For fully commercialized farms which are privately held and producing for open markets, the model is less helpful in explaining what is happening. It is this latter farm setting which we see as dominating in the twenty-first century as we become increasingly concerned about an adequate supply of cheap food from a sustainable agricultural system, and are politically willing to regulate for sustainability as increased knowledge of the environment permits.[3]

What organizational structure makes sense in this environment?[4] To us, it is one that is able to accommodate a production environment where there is a large set of external signals in addition to prices to which the farmer must react. This set includes public opinion, what is going on in public hearings on the environment, more information about alternative sources of supplies and prospective markets for products, what other farmers are doing, trends in consumers' food preferences, the public's image of food and fiber producers, what is coming down the information highway with respect to competing sources of supply in an international setting, and what is being uncovered in research centers as prospective new technologies.

This list is not at all exhaustive, but it suggests that a primary producer who wants to be an independent entrepreneur will either need to spend more time handling and managing information and hence less time doing the physical work. This implies depending more on hired labor and perhaps hired production managers. An intermediate step, which is being increasingly used in the North and the South, is to produce subject to a written contract with an agri-business firm that needs a well-defined agricultural product. In this contractual environment, the major decision a farmer will make is which contract to sign. However, fixed investment and experience requirements will tend to lock individual farmers into similar contracts over time. As we look to the future these contracts will include provisions to satisfy environmental and food safety issues.

This scenario we paint means agricultural economist interested in agricultural production will need to work in an increasingly interdisciplinary mode with those who have expertise in such areas as ecology, business -- especially organizational

management, sociologists, and environmental and business law, to name a few.

Implications for Global Economic Development

If correct in our assertion that forces driving our quest for agricultural sustainability are also, in large part, driving us toward the industrialization of agriculture, there are some profound implications for economic development--especially if the current trend toward privatization and openness continues. It now looks as though we are moving toward an environment of greater security for private international investments in developing countries. If this is true, developmental assistance will come increasingly through private investments in less-developed countries. There will be exploitive aspects of such investments. Indigenous human-capital capacities to guide and monitor external investments have improved in many developing countries. However, these capacities remain quite inadequate in terms of the need. Also, multi-national and other large firms are increasingly operating in an environment where the world is watching--the CNN effect. Governments will be increasingly pressured to produce public goods which help to keep transaction costs low with an efficient set of ground rules that are sensitive to issues of sustainability.

Joint Ventures Between Governments and the Private Sector

The development of a sustainable agricultural system will require both public and private input. A satisfactory resolution of the issues will require joint efforts in an rather open public-hearing type environment that is sensitive to distributional, social, and environmental interests. This is a difficult challenge and an area where development assistance from both government and non-government organizations can play a hands-on role in countries with inadequate public-sector capacity to fully study the issues. Indeed, some undeveloped countries are pleading for help. For example, President Cheddi Jagan recently called for such assistance in developing the interior of Guyana.[5] He was arguing that his country could not afford to leave its interior in its near natural state. However, he fully recognizes the need to use this large portion of Guyana in a responsible and sustainable way which would be sensitive to the needs of the indigenous population. He extended an invitation for external help. A problem is that there is a broad recognition of the need to use and preserve resources in a sustainable way, but little real insights in just how to do it.

Technical Assistance from Private Sector

With additional private investment this sector can and will provide much of the developmental assistance needed in the technical areas of production and marketing. The quest for intellectual property right will also encourage a continuation in the trend toward more research being conducted and/or funded in the private sector. This will also be true in developing countries where added research will help protect investments. Research will offer another area for joint public/private activity. Private agri-business companies on the input side of agriculture will also play an active role in providing and/or assuring more adequate capital.

Implications for Global Sustainable Development

We began the last major section assuming that the trend toward privatization and openness continues. If it does not, the future does not look very hopeful for the world's poor. We come to this position from the rather dismal past performances of closed and bureaucratically controlled economies where most of the poor live (Krueger). Such economies do not have a very good track record of being responsive to human rights or the needs of the poor and the environment. They have, however, done a good job of encouraging high rates of population growth. In short, the performance of economies in such circumstances have not been encouraging for the achievement of sustainability objectives.

While we see the privatization and economic openness phenomena as fundamental ingredients in the agricultural industrialization process, we none-the-less recognize that such processes could create significant positive as well as negative effects from a global sustainable development perspective. Privatization and openness as components of a global agricultural industrialization process are rapidly gaining ascendancy as development strategies. These trends are antithetical to the strategies of discouraging

private initiatives in production and encouraging state owned enterprises which were dominant in many countries during the early 1960s and 1970s. Privatization of the agricultural sector in the South as a concomitant part of the global agricultural industrialization phenomenon has involved specific elements, inclusive of: (1) cessation of public programs and disengagement of government from specific responsibilities (2) sales of public assets, including public lands, public infrastructure and public enterprises (3) financing private provision of services through contracting, etc., and (4) deregulating entry into activities that were previously traded as a public monopoly (Bienen and Waterburg; Davis, 1993). How do the privatization, openness, scale, and other dimensions of the agricultural industrialization process impact the attainment of global sustainable development objectives? We argue that the specific effects of the process will be manifested in large part via how the *characteristics* of the market-place interacts with the *public policy framework* which governs how firms (and industries) go about making their pricing and production decisions (Ghatak and Ingersent).[6]

The characteristics of the interactions between agricultural industrialization-related market forces and agricultural sustainability objectives are likely to occur in a dynamic nexus between and among: (1) economic growth (scale) effects (2) equity (income distribution or poverty) effects and (3) agriculture-related environmental assets integrity effects. A basic assertion of this paper is that while the agricultural industrialization process and the quest for global sustainable agriculture systems are consequences of a set of similar forces, that it might be costly from both a socioeconomic and an ecological point of view, to assume that economic growth (scale), equity improvement (poverty reduction) and environmental quality parameters move in lock-step with each other. These elements can, and often do conflict at least while we are in a learning-by-doing mode, and we now turn to identifying some areas of potential conflict.

A substantial (but by no means exclusive) set of the issues relating to potential growth, equity, and environmental quality conflicts has to do with market and/or policy failures. The welfare implications of market or policy failures under the agricultural industrialization phenomenon are real, and could be horrendous for all societies, but more so for developing countries. Market failure exists when social costs or benefits diverge from private costs or benefits. Policy failure exists when: (1) the public sector fails to redress market failure through legal, regulatory, economic or other means when it is clearly feasible to do so or (2) when public sector activity magnifies existing market failures (Miranda and Muzondo). The key determinants of potential market and or policy failures that are likely to compromise the convergence of economic growth, equity improvement (poverty reduction) and environmental sustainability under agricultural industrialization are: (1) the nature of the economic growth path, (2) the level, source, and pattern of agricultural sector productivity, (3) the state of knowledge, and (4) the levels of economic efficiency (technical and allocative) and the avoidance of waste in agricultural resource use. It is imperative that private sector-driven sustainable agricultural development *cum* poverty reduction growth paths, passes through undistorted, competitive-like, and well-functioning factor and product markets (Davis 1993, 1994).

It is argued that the prevailing configuration of markets and policy regimes under which developing countries operate, result in dissociation between resource scarcity and price, benefits and costs, rights and responsibilities, actions and consequences (Panayotou). Countries in the South are becoming increasingly cognizant of the signals being sent via the division of world markets into regional trading blocks (EU, NAFTA, AFTA MERCOSUR, APEC) that their survival in global markets is going to be based largely on increased competitiveness. However, the reality is that under the configuration of existing markets in many developing countries, many resources are outside the domain of markets. Under these conditions, the market configuration acts as a subsidy by general taxpayers to the excessive use, waste, inefficient allocation, resource depletion and degradation of these extra-market resources. As such, tax transfers prevent resource prices from rising in line with growing resource scarcity and rising social costs. Thus, they dilute the cost of increasing resource scarcity and foster the types of dissociations referred above, which are the basis of market and or policy failures.

The tendency of market configuration to generate dissociations and hence market and or policy failures, can be compromised by institutional reforms and policy intervention mechanisms. It is within this context that the argument was made that, "A market failure is nothing but a policy failure, one step removed" (Panayotou, p.357). We are in agreement with this argument. We thus take the position that whether there is convergence or divergence among the economic growth (scale), equity improvement, and sustainability of environmental assets elements under agricultural industrialization, is going to depend to a large extent on: (1) early recognition on the part of countries that the state can play a critical role in shaping and directing developmental goals and outcomes via public policy and (2) that public policy as a facilitator of private sector driven welfare gains, is only effective to the extent that associated policy instruments are effective. It is increasingly being recognized that policy failure, like market failure, is essentially microeconomic in nature. As such, they can be effectively addressed via new microeconomic instruments and or recalibration of existing microeconomic instruments (Miranda and Muzondo).

The debate surrounding the convergence-divergence issue among elements of economic growth, equity improvement (poverty reduction), and agricultural sustainability in developing countries was recently captured in the observation that, "Developing countries that are struggling to escape poverty and meet the growing aspirations of their still-expanding populations find the concern for sustainability an added burden on what is already a Herculean task" (Panayotou, p.355). In analyzing the growth, equity, sustainability issue, Panayotou comes to the conclusion that sustainable development as a concept implies benefits to both current and future generations. Two key questions regarding the meaning of sustainability served to inform that conclusion. One question is whether sustainability means Spartan living by the current generation of the poor so the next generation of the poor will have a better standard of living, and if that is the case, where is inter-generational justice. The other question is whether sustainability means that future generations should enjoy the same level of poverty as the current generation, and if that is the case, why sustain poverty.

The above argument is further advanced that poverty reduction (equity improvement) and sustainable development objectives have the potential for convergence as the system moves along a trajectory. It is suggested that sustained economic growth is a key conduit for poverty reduction, and the latter is critical for the attainment of sustainable agricultural development (Vyas). We are in agreement with this argument. As such, we explicitly reject the notion that economic growth (scale) as a phenomenon, is congenitally linked to *degradation* of environmental assets. The converse would also hold, that non-growth is congenitally linked to the *preservation* of the quality of environmental assets. Davis (1992, 1993, 1994) expanded on and applied similar arguments advanced by Panayotou and Vyas to the situation in the Caribbean. He concluded that it is the *source* and *patterns* of certain factors that accompany either economic growth or non-growth that is the major correlate of decline in environmental assets over time, and that these combined factors reflect either market and or policy failures.

Under agricultural industrialization trends, a major source of potential market and or policy failures that might be associated with economic growth (scale) is the level, source, and pattern of agricultural sector productivity. The *orientation* of agricultural technology practices is not *neutral* with respect to economic efficiency (technical and allocative efficiencies). Depending on the stage of modernization of the agricultural sector, the technological package could to varying degrees, affect the technical (productive) efficiency of the agricultural sector in ways that could profoundly impact environmental quality and income distribution. Current agricultural technology practices are heavily oriented toward increases in productivity (in terms of yields) via intensive energy such as chemical fertilizer, pesticides and fungicides. Although agricultural research programs are giving increasing attention to the development and adoption of technologies that generate sustained increases in productivity with decreasing dependency on chemical energy, much remains to be done. This is particularly true in many less-developed countries where both the economic realities and the general educational levels lead to less social concern for the potential effects of residual chemicals in the environment. We believe

that in such countries, greater economic development is a necessary condition for a level of public concern for the environment that will support the attainment of a sustainable agricultural system.

Pomarada Benel (1991) argues that commodity-oriented chemical intensive technology attempts to *indirectly* increase the marginal productivity of rural labor by displacement of labor from rural areas. This process is accomplished by the substitution of chemical energy for human energy. Such a technological orientation could increase the incidence of rural poverty in many countries via increased levels of rural unemployment. The point being made, is that greater complementarity among growth (scale), equity, and environmental assets integrity, could be accomplished by conscious public sector-directed policies and programs (with private sector support) which seeks to harmonize the use of human and non-human energy in the agricultural technology practices in developing countries.

In more developed countries, there is less pressure on the agricultural sectors as a source of rural employment of landless labor. However, agriculture has an image problem in that this sector is viewed as one of special interests with too little concern for the environment. This image problem is likely to become more pervasive with the industrialization of agriculture, even though an agriculture with larger firms and better management is probably necessary to attain sustainability through scale economies.

From a sustainability perspective, it is in the interest of agriculture to work jointly with environmental interests in resolving issues. Parties to the debate need to admit that they are very much in a learning mode as how to attain sustainability, that they all have legitimate interests in this issue, and that they all must become concerned and involved in learning and operationalizing the processes needed to attain the goal of sustainability.

One important component of the sustainability puzzle is that the poor, who will increasingly reside in urban areas, need an abundant (low-priced) supply of nutritious food on a sustained basis. An industrialized agriculture with modern organization and management tools and precision production techniques has an important role to play. And as Schmidheiny has pointed out, in playing this role profits are not incompatible with sustainability. However, we hasten to point out that a negative growth rate in multi-factor productivity is incompatible with sustainability in a situation of increasing population, as we will likely be in well into the twenty-first century. To assure positive growth in productivity to accommodate this increasing population without exploiting resources needed to assure sustainability, we must exploit potential productivity gains from increased scale of activity.

Economic concentration also represents a substantial part of the potential for divergence in the growth (scale), equity, environment assets quality dimensions of welfare gains associated with agricultural industrialization. Such concentration could come about through corporate mergers, acquisitions, and other forms of market consolidation. It is critical that developing countries in their quest for complementarity among economic growth, equity improvement, and sustainable environmental assets, bear in mind the basic rule that every policy goal must have a policy instrument (Tinbergen). Conscious efforts to reorient the agricultural technology practices globally must have their own policy instruments and these instruments must be consistent with other macroeconomic and microeconomic policy instruments. One characteristic that appears to be critical for convergence of strategy goals in developing countries is one that has been referred to as "inclusionary" growth and development strategies. Inclusionary strategies, "requires combinations of intervention directed toward structural change, active social welfare programs, and simultaneous attention to private incentives and macro-economic constraints" (Sheahan, p.40). Sheahan also argues that inclusionary growth and development strategies require not only consistency in policy instruments, but that the non-poor actively participate in and enjoy security from the gains in growth.

Concluding Remarks

Agricultural industrialization trends and the quest for sustainable agricultural systems are contemporary issues of global importance. The concerns expressed regarding the processes

associated with both trends appear not to be ephemeral. There appear to be a permanent shift in public attitudes with respect to the social welfare gains associated with these phenomena. As such, the issues associated with the processes are likely to rank high on the agriculture/natural resource policy agenda well into the twenty-first century. Agricultural economists have much to offer to the policy dialogue and to pragmatic policy formulation on the issues. Their rich tradition of applied economic analysis and public policy orientation should serve to make the profession well-positioned to make substantive contributions to the problems associated with the trends. It is clear, however, that the profession will only be able to make significant policy contributions, to the extent that it recognizes that these trends will necessitate changes in the traditional boundaries of farm firms, and thus of the food and fiber and natural resource issues. As such, its analytical paradigms (models) and approaches must by necessity, reflect a new perspective on the policy formulation process and performance indicators for the global food and fiber system. We have attempted in this paper to take a first step in that direction, by addressing some of the conceptual dimensions of the issues resulting from these highly interrelated processes. We challenge the profession to continue the journey.

We see the agricultural industrialization trend and sustainable agriculture quest as both consequences of similar global forces. We also see the two processes as finding manifestation at a nexus between and among the three elements: (1) economic growth or scale (2) income distribution or equity and (3) agriculture and natural resource quality. The agricultural industrialization process will provide opportunities for improvements in these three elements on a global basis. However, convergence of the three elements is not automatic, and we have attempted to identify and elaborate on factors contributing to non-convergence (divergence).

It is doubtful if we can overestimate the impact of the information and openness explosions on the development processes. Information like all inputs, is not without costs and there are great potential economic benefits including economies of scale to those who can access and navigate the "information highway" in an open global setting. It will facilitate large-scale, precision farming that will lead to productivity gains and lower resource costs, and will increasingly lead to a greater separation of the management and labor functions in agriculture. Fear of the size and distributional consequences will make it politically difficult for developing countries to embrace these trends--especially those which have a history of colonial rule and an estate culture. However, for long-term development in a competitive and sustainable way these countries will not be able to ignore scale economies.

A major policy implication flowing from our assessment is that there is an *altered* role for the public sector in the new era of reconciling agricultural industrialization objectives with those of agricultural sustainability. This altered role will be one of *qualitative* improvement in the *intervention capacity* of the public sector as it attempts to implement development strategies. Qualitative improvement in this capacity would cover areas such as: (1) the function of the public sector (2) the administrative structure (3) the procedures used and (4) the skills and management systems required. Within the context of this improved capacity, high priority must be given to setting in place policy instruments and institutional reforms that compromise market and/or policy failures. Such policy instruments must originate from joint public sector, private sector and "grassroots" elements of those whose behavior we are trying to change. Some of the important instruments and reforms would include: (1) elimination of direct and indirect subsidies, giveaways, and public projects that promote environmental degradation and pollution (2) ensure that the cost of environmental degradation and pollution is borne by those who generate them and derive the benefits, rather than the general taxpayers (3) develop the institutional entities that would expedite efficient functioning of environmental and resource markets (4) create and ensure market-based economic incentives and disincentive and structures to internalize externalities (5) subject public and private projects to rigorous scrutiny and environmental assessment and (6) develop a natural resource accounting framework to be used in conjunction with an economic accounting framework to evaluate welfare gains.

Finally, we feel that the emerging problems will not be solved in the agricultural sector alone,

but that agricultural policy will need to be more fully integrated into industrial and macro-policies. Our danger is in erring on the side of agricultural fundamentalism, and not thinking more broadly in working through the problems we will increasingly face with non-agricultural interests--especially on sustainability issues.

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Endnotes

1. For example, Johnson (1994a) presents an interesting account of rural population policy in China and the inconsistent signals the policies send to the rural families. His discussion suggest that rural population may be endogenous contrary to what we economist generally assume and that policies to directly lower the population conflict with the government's manipulation of some exogenous instruments which set in motion individual decisions by farmers to increase their family size.

2. For example, on a field trip by one of the authors to a Pioneer Hybrid plant in Zimbabwe, seed corn was packaged in sizes starting at 5 kilograms for sale in local markets to small farmers who used public buses for transportation to sacks of 100 kilograms for direct sales to large producers.

3. Problems and issues relating to subsistence and near-subsistence farming systems will require *more* rather than *less* attention in this setting. A good proportion of the issues in this setting will revolve around the questions of income distribution (poverty), health, food security, inclusionary growth, and social justice.

4. Several economists have written on the organization and its economic role in production and how organizations influence the structure of economic activities (for examples Barry, et.al, Simon, and Stiglitz).

5. Presentation at the Hemispheric Conference on Agribusiness in the Americas in conjunction with the 18th Annual Miami Conference on the Caribbean and Latin America, December 11-15, 1994.

6. It is this interaction between market characteristics and the public policy framework that gives meaning to the performance criteria. Many developing countries pursue privatization strategies on the assumption that it will improve technical and allocative efficiencies in the agricultural sector. However, there is no direct theoretical economic linkage between allocative efficiency and the ownership or control of resources. Allocative efficiency simply requires that factors be combined in ways such that the ratios of their marginal productivities are the same as this relative prices.