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A COMPARATIVE STUDY OF THE LINKAGES IN THE DEVELOPMENT AND USE OF SELECTED AGRICULTURAL AND ENERGY RESOURCES OF THE USSR AND THE USA

By

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ABSTRACT

A COMPARATIVE STUDY OF THE LINKAGES IN THE DEVELOPMENT AND USE OF SELECTED AGRICULTURAL AND ENERGY RESOURCES OF THE USSR AND THE USA

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The change from human and animal energy use to petroleum, natural gas, coal and electricity energy sources in agriculture has been a phenomenon in both the USSR and the USA. This study was designed to explore this change in several dimensions. In so far as possible, observations from the literature and personal experiences were advanced to explain the similarities and differences in the use of energy in the crop and livestock sectors of these two countries.

Findings of this study show that the change from human and animal energy to other sources has been spectacular in both countries. About 20% of the labor force in the USSR (2% in the U.S.) is in agriculture, the USSR in recent years has increasingly used certain of its energy resources in agriculture. Both countries use large amounts of natural gas for nitrogen fertilizer

production. The increase in use of energy in most agricultural sectors in the U.S. has reached a peak, but there are still opportunities to increase the use of energy in the USSR. This is true in fertilizers and in more modern fleets of tractors, combines and trucks. It does appear that increases in energy use in agriculture in the USSR is on a trajectory that may bring it close to rates used in agriculture yet this century if certain obstacles and impediments can be removed.

Data for more detailed analyses on this topic was not available. More specific data on the machinery inventory in terms of age, horsepower, size, and energy consumption would have been very helpful. As more openness occurs, it may be possible to gain information about why a large percentage of the labor force remains in agriculture, why more fertilizer production is not resulting in significant increases in crop production, and what kinds of obstacles remain in the delivery systems in getting energy to the farms in the USSR. These are truly exciting research opportunities that may become available in the future.

DEDICATION

To my parents, Mrs. Rachael Simisola Oriyomi and Deacon Abraham Oladunwo Oriyomi who gave me the aspiration to succeed and glorify the name Oriyomi.

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I wish to express my gratitude to Dr. Milton H. Steinmueller for serving as my guidance committee chairman and thesis advisor. He willingly devoted a generous portion of both professional and personal time to discussions concerning this research, for which I am most appreciative. His patience, encouragement, and valuable assistance in directing the course of my study are gratefully acknowledged.

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I thank my sisters, my brother, Mrs. Bamgboye and Mr. Aderinola Adewumi for their interest and support of my goals and aspirations. The patience and encouragement shown by my parents through my years away from home eased the burden on my mind. We all earned this. I love you all.

My work could not have been completed without the selfless support and encouragement from my numerous friends. To you all, I say thanks.

Most of all, I give ceaseless praise and thanks to my Creator who has made everything possible by the breath of life. Thank you, God.

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CHAPTER I

INTRODUCTION

This study is concerned with the question of providing a wide-ranging survey of the past and present situation of the agriculture and energy sectors of the economies of the United States of America (USA) and the Union of Soviet Socialist Republics (USSR). No pretense is made of constructing a complete picture of either the entire Soviet economy or that of the United States. Rather, the concern is primarily looking into the development[1] process as related to the agricultural and energy resources,[2] and within this process, to focus on the linkages in the development and use of some selective

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[1]As a normative concept, "development" implies choices about goals. It is often used interchangeably with the concept of progress and growth.

[2]According to Randall (Alan Randall, "Resource Economics," An Economic Approach to Natural Resource and Environmental Policy (2nd ed.) (Columbus, Ohio: Grid Publishing Inc., 1986), a resource is something that is useful and valuable in the condition in which we find it. In its raw or unmodified state, it may be an input into the process of providing something of value, or it may enter consumption process directly and thus be valued as an amenity.

agricultural and energy resources of the USSR and the USA.

The current pictures of the U.S. and Soviet economies are one of economies that have reached their present position by driving ahead fairly steadily in their distinctive ways. Each national system is at least in some respects, peculiarly distinctive and unlike any other. Each has achieved some combinations of results including those both favorable and unfavorable. Yet Soviet economic performance is not satisfactory in the eyes of the Soviet Authorities, nor is it impressive in comparison with the economic performance of other successful countries, such as the USA.

This study will first present economic-historical trends of both economies of the USA and the USSR with regard to their energy and agricultural sectors. Second, the study will probe into the use of selective energy resources in agricultural development and their respective linkages in the development of both economies with emphasis on the Soviet experience, modified where appropriate by the effect of recent occurrences in the Soviet Union, such as "Perestroika," which, on the whole, has brought only minimal improvements thus far.

By trying to evaluate the economic systems of the USSR and the USA by isolating the performances of the agriculture and energy sectors, the number of observed

unit of analysis are ordinarily too small for the application of statistical analytical methods and also, many of the factors at play are difficult to quantify. Especially in the Soviet Union, it has been shown that performance, itself, is not a clear-cut quantifiable notion.[1]

Problem Statement and Study Objectives

It is the task of the field of economics usually called "Comparative Economic Systems" to describe how national systems differ and to explain how and why these differences come to be. Such studies seek to reveal why one system has produced one set of results and another a different set. It attempts to speculate upon how each system might be altered, perhaps by making the system more like or less like some other, so as to produce a somewhat more favorable combination of results than those already achieved.[2] It also tries to indicate how alterations, if made, may create a less favorable outcome than that presently enjoyed.

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[1]The reader is advised to treat the tables and numbers used throughout this study as indicators of trends; for all other purposes, they are best considered approximations and used with caution.

[2]M. C. Schnitzer and J. N. Nordyke, Comparative Economic Systems (Chicago: Southwestern Publishing Co., 1983), p. 3.

One thing stands clear though, the USA is an economic power and giant in a true sense of the words, much as the Soviet also stand out in an enclave of its own. The U.S. advantage in the past and present has always been in the matter of agriculture. Industry and its growth have shown to be fairly tolerant as to forms of organization.

This study is a probe into the imbalances that exist in the past and present development and use of resources in the agricultural and energy sectors of the economies of the USA and the USSR, spanning the time mostly between 1960 and the current period. There is numerous literature attesting to the existence of a number of disparities between the development and use of the agricultural and energy resources of the USA and USSR. Particularly in these two divergent socioeconomic systems, one finds significant differences in the levels of development attained by these principal economies.

The energy and agricultural sectors have been chosen for a comparative study because of the significant roles of both sectors in the past and present development of both countries. Primarily, all other developmental efforts and achievements of various economic goals in both countries (USSR and USA) have been related directly or indirectly to the progress made in these two fundamental sectors.

To describe and explain these basic national settings with a focus on the extent of energy use in agriculture in the economies of the USA and the USSR, is the overall objective of this study. More specifically, this objective can be subdivided as follows:

Objective 1: To identify the differences in the level of development and use of selective agricultural and energy resources of the USSR and the USA with emphasis on the periods from the 1960's until present time.

Objective 2: To identify the trends in growth rates and national disparities in their various planning periods with regard to development and use of these selective agricultural and energy resources (contingent on availability of pertinent data).

Objective 3: To identify the major problems of the two countries in terms of energy use and efficiencies (or inefficiencies) in selected agricultural production sectors.

Objective 4: To suggest measures for improving on existing strategies for securing an improvement in current situations in both countries that might generate a better energy use performance.

Brief Literary Precedences and Need for Study

The history of agricultural development and reasonable indicators of energy development and use in the USA have been highly documented. Relatively, the pattern of resource development in the USSR, though an inchoate field of inquiry, has always attracted a considerable amount of scholarly attention.

Already, three principal historiographical trends have emerged:

The first strand involves studies of the economic history of the USSR that are included in the general work of development in East Europe, such as the work by Robert Deutsch,[1] where he looked at a comparative relationship between food and politics in the countries of Eastern Europe with emphasis on the current food revolution as part of the modernization process.

The second strand deals with the specialized aspects of the economy, namely, the political system holistically, the marketing trends, and reactions to visible economic changes in this current age of reforms, such as the work of Thane Gustafson,[2] where he looked at the politics of Soviet energy under various Soviet leaders and a discussion of the Soviet energy crisis amid plenty.

The third strand is directed toward an assessment of the ever-changing performance of the Soviet economy in the current breeze of changes called "Perestroika" or "Restructuring." Detailed discussion on this aspect with

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[1]Robert Deutsch, The Food Revolution in the Soviet Union and Eastern Europe (Boulder, CO: Westview Special Studies, 1986).

[2]Thane Gustafson, Crisis Amid Plenty--The Politics of Soviet Energy Under Brezhnev and Gorbachev (Princeton, N.J.: Princeton University Press, 1989).

reference to agriculture can be found in the works of Josef C. Brada and Karl Eugen Wadekin[1] on the Socialist Agriculture in Transition, with numerous other academic contributions by various scholars of Sovietology, evaluating the current reforms and changes being introduced in the USSR. The major focus has been on a comparison of the Soviet experiences with the successes of the Chinese and Hungarian reorganizations and some other reforms in the other socialist countries, such as German Democratic Republic, Vietnam, Yugoslavia etc. (Socialist Agriculture in Transition, 1988).

The works of scholars, such as Marshall T. Goldman, Robert Legvold, Milton Friedman, Martin C. Schnitzer and James Nordyke, Alan G. Gruchy, Robert W. Campbell and Thomas Ferguson, to mention a few, provide useful statistics on political histories, economic trends, the coming of age and maturity of both the Soviet and American economies. They also contain detailed information on the mechanisms for doing a thorough comparative analysis of market vs. nonmarket economies, and the impact of government policies on resource development and use. It would, nonetheless, be

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[1]Josef G. Brada, and Karl-Eugen Wadekin, eds., Socialist Agriculture in Transition--Organizational Response of Falling Performance (Boulder, CO: Westview Special Studies, 1988).

interesting to know the changes that took place in the patterns of planning prioritizing, and different forms of integration of the networks of the various sectors of the economies and their implications not only for the economy of resources, but the political-economy impact as a whole.

Perhaps the most authoritative work on the comparative analysis of the economic history and development of the USA and USSR, engrossing the role of resources in their various stages of development are the work by Wilson Clark (1975),[1] concerning the USA, detailing past and current concerns of energy use and changes that ought to be made to survive the pressure of the future; and the work by Michael Ellman,[2] detailing the historical trends that culminated in the present precarious state of the Soviet Economy and lead to a focus on the changing events in the present stages of "Perestroika" or "Restructuring." Attempts are made at synthesizing eras of planning and developmental stages in both systems, examining political trends, capital formation, and the ways in which the systems of

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[1]Wilson Clark, Energy for Survival: The Alternative to Extinction (New York: Anchor Press, 1978).

[2]Michael Ellman, The USSR in the 1990s--Struggling Out of Stagnation, Special Report No. 1152 (London: The Economist Intelligence Unit, 1989).

government operate. There is a focus at the kind of influence that the different political structures have on the performances of the alternative political-economic institutions. Indeed, their work is to be welcomed as a pioneering attempt to grapple with the burning issues of economic development and role of resources. It will definitely provide the stimulus for further research on this subject.

However, the above-cited works, and numerous others, do not account for the ever changing nature of the energy and agricultural sectors of both economies. Instead, such discussions are entrenched in the massive analysis of the holistic operations of the economic system of the USA and the USSR. Furthermore, there is little information detailing the linkages between the energy and agricultural sectors of both economies that have evolved in recent years, and no detailed empirical analysis of changes in the role of energy in agriculture of both economies is readily available. It is in light of this that the following research questions are raised for examination.

Research Questions

The following major research questions are sought to be answered:

Question 1: What are the objective indications which show significant disparities in the level of development in both the agricultural and energy sectors of the economies of the USSR and USA?

Question 2: How have these inter-country disparities grown over the years and various planning periods in the USSR and the development of the USA?

Question 3: What (if any) are the existing similarities and differences in the levels of energy use and energy efficiencies in agriculture in both the USSR and USA?

Question 4: What measures can or should be taken for closing the existing "performance gaps,"[1] toward securing balanced economic development along scientific lines and relaxing of the bureaucracy in the USSR to generate a better performance in the near future?

Method of Approach

This study employed the historical, descriptive, and empirical methods of research in most parts. The source of information included books, official reports, materials collected from state archives, national libraries, firsthand information from personal experiences, and visits to some administrative offices, such as the USSR Embassy in Washington, D.C.; the offices of the Economics Intelligence Unit in New York, Economic Research Services of the U.S. Department of Agriculture in Washington, D.C. and empirical evidence collected from

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[1] "Performance gap" is said to exist when "what ought to be" differs from "what is" in the expectation of performing a given role.

selected nonofficial sources, regarding the various major activities of resource development in both the USSR and USA in past and recent years.

Besides the published and unpublished documents available in the United States, various bibliographies, books, periodicals, and newspapers relevant to this study were used as sources of information. A comparative study of the problem with regard to use and development of agricultural and energy resources and the effective linkage of energy use in agriculture in both the USSR and USA were made.

Organization of the Research Topic

This study is presented in five chapters. Chapter I includes an overall perspective, introductory remarks, the study problem and objectives, brief literary precedences and need for the study, the research questions, method of approach, and the scope and delimitation of the study.

Chapter II contains empirical research into the economic-historical trends that shaped the current economic stands of the USA and USSR. An attempt was made to grapple with past developments over time in order to identify differences in the structures, to point out, if any, objective indications that might show any significant disparities in the level of development of

the general economies of the USSR and USA. This is done by a comparison of the level of growth of their GNPs and selected indicators, for a better understanding of their general economic orientations, comparison of productivity and growth figures for past and recent years (as available), in an attempt to answer Research Question 1. There is a probe into the various national goals set for the near future with regard to their agriculture and energy sectors.

Chapter III is a descriptive analysis of recent achievements in the use of the energy and agriculture resources of the USSR and the USA toward a fulfillment of their various goals, by comparing trends in recent developments, to determine if there exists indicators showing any widening or narrowing of disparities (as identified in Chapter II above) over their recent periods of economic growth, with regard to development and use of their energy and agriculture resources since the 1960's, in answer to Research Question 2.

In Chapter IV an attempt was made to answer Research Question 3 by evaluating the performances of each economic system in the use of the available energy resources with respect to agricultural development, and look at the means that might be used to close any identifiable "performance-gaps" as identifiable in both sectors of the economies in earlier chapters.

Chapters V and VI concludes the study topic with a probe into the future, suggested propositions toward securing a balanced economic development with regard to the use of their agricultural and energy resources, in answer to Research Question 4. Suggestion for future research needs are forwarded that could better shed more light on our understanding of the topic in discussion.

Scope and Delimitation

It was not the purpose of this study to defend any existing school of thought; rather, it intended to unravel the tangled skein of available data and information toward finding a reasonable explanation for the present performances of the delineated socioeconomic system of both the USA and the USSR as related to the energy and agricultural sectors and their interaction. There has been, and continues to be, a tremendous change in the political situation in the USSR, having a massive effect on the economic development and, consequently, the agricultural and energy policies, thus further limiting the accuracy of any attempted prediction or prognosis. This study addressed these lacunae from a twofold perspective.

First, the relationship between central planning[1] and allocative efficiency was examined in the context of the economy of the USSR, trying to achieve the one overriding goal of coming out of a stagnant stage in their economic progress. No pretense was made of constructing a complete theory of a centrally planned economy. Rather, the aim was much more limited. This study was concerned only with the problem of agriculture and energy resource allocation and use in the development process. Selective agriculture and energy resources were examined with more focus on the period from the 1960's to the present.

Second, in relation to the above perspective, it is recognized that no economy does a perfect job of allocating resources. The important question is, what type of economy has the least misallocation[2] comparing the USA and USSR.

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[1]Central Planning is defined as a prospective national account, a representation of a future economic structure whose basic economic flows and inner connections are expressed in a statistical form. The national accounts, understood in the restrictive sense of accounts of independent material flows (excluding services) are expressed both in physical and in monetary terms.

[2]In this discussion, misallocation is defined as inappropriate use of available resources and their disposition, apportionment or wrongful assignment of their uses for specific purposes to aid their economic development. Many economists studying the Soviet Union argue that central planning results in both technical and allocative inefficiency.

According to Gustafson,

> Overlapping the problems of systemic structures are those of process. The centrally managed economy generates more targets than managers can meet. The incentive system encourages them to respond by giving priority to the targets that will preserve their jobs and their incomes, which usually means the gross output target or some functional equivalent to it. The result is imbalance, which must be reallocated through constant corrections at all levels of the system, which put still further pressure on managers. The system in theory is planned and predictable; in practice, it is negotiated and fraught with risk and conflict for all the participants. In theory, it concentrates control in the hands of the leaders and planners; in practice, much of the control is dissipated, except or the handful of near-term targets that the leadership chooses to put first.[1]

The author addressed planning mechanism, government policies, and existing conditions of research and development in both institutions in order to determine the extent to which they have contributed to the present performances as related to the delineated sectors and periods of analysis.

Apart from problems stemming from the lack and nature of raw data, this empirical study has to contend with the above-stated limitations regarding the scope of the performed calculations. This investigation did not construct input-output tables nor attempt a measure of

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[1]Thane Gustafson, Crisis Amid Plenty--The Politics of Soviet Energy Under Brezhnev and Gorbachev (Princeton, NJ: Princeton University Press, 1989), pp. 308-309.

the rate of technological change. Appropriate data for this detailed analyses was not available. For instance, it would have been helpful to have disaggregated data at least to the regional level. The study, though, discusses the constraints to the transportation of Soviet energy resources. The purpose is to determine the general pattern of movement for each of the main forms of energy used directly or indirectly in agricultural production (gas, coal, refined products, and electricity), to evaluate the prospects for future development and uses.

CHAPTER II

NATURE OF THE ECONOMIC SYSTEMS

General Economic Background

The USSR

Any description of the Soviet Union has to start by emphasizing its sheer size. With an area of nearly 816 million square miles, of which less than a quarter lies in Europe and the rest in Asia, it is the largest country in the world in terms of land area and it is larger than the United States and Canada combined. It occupies the main northern continental mass of Europe and Asia, with coastlines on the Black Sea to the Southwest, Baltic Sea to the Northwest, Arctic Ocean to the north, and Sea of Okhotsk, Bering Sea, and Sea of Japan to the east (see Figure 1).

Norway, Finland, Poland, Czechoslovakia, and Hungary are to the west, Romania to the southwest, and Turkey, Iran, Afganistan, China, and Mongolia to the south; there is a shorter border with North Korea in the east and Alaska (United States) is to the east across the Bering Strait and Japan to the southeast across the Sea of Japan. In short, it extends from Finland the Baltic Sea in the west to the Pacific Ocean in the east and

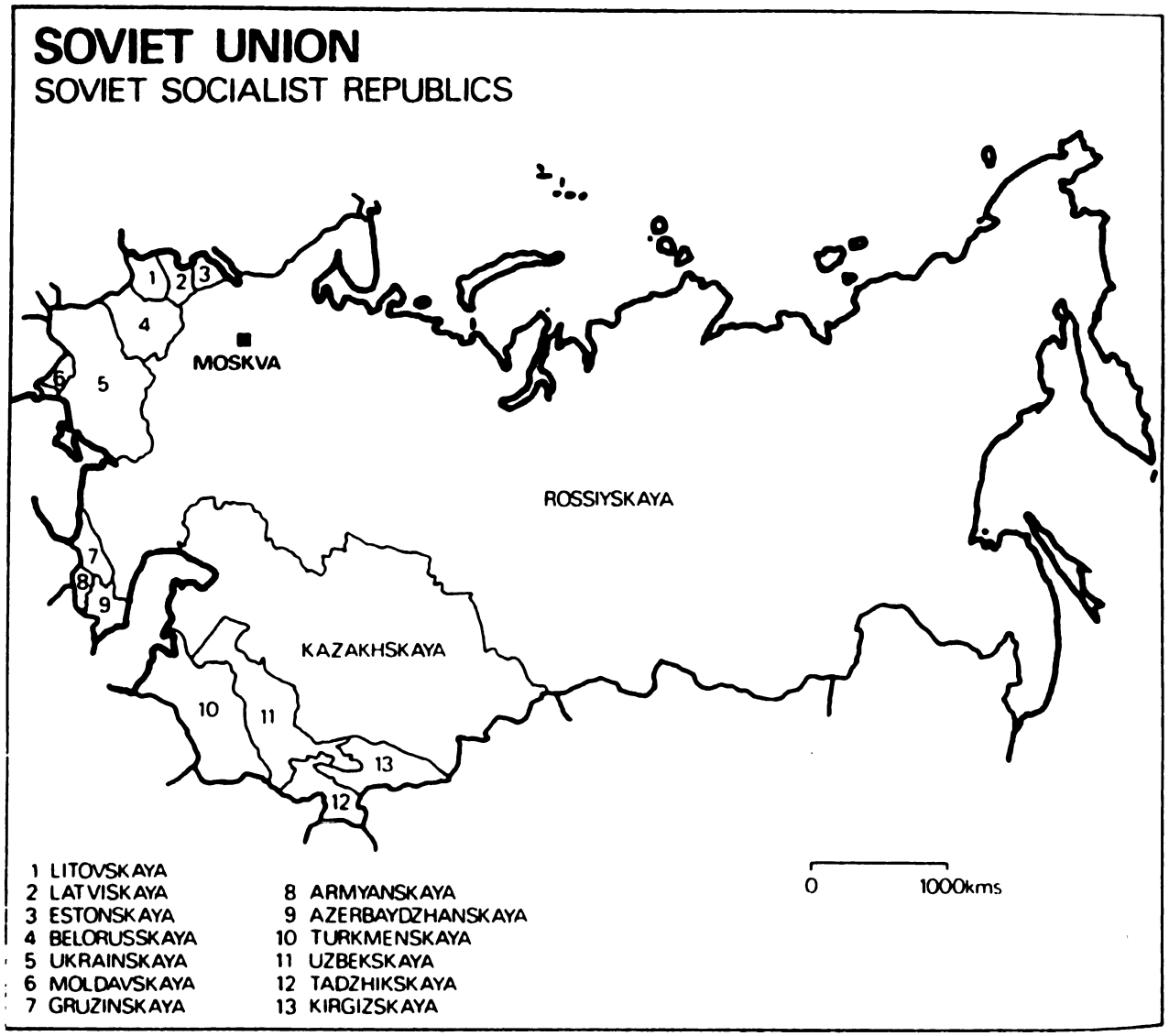

Figure 1. Map of the USSR.

covers approximately one-seventh of the earth's inhabited land area. It stretches over 6,000 miles from west to east and nearly 3,000 miles from north to south, with nearly 40,000 miles of frontiers with 12 countries. The land inhabited by the Russians and national minorities is for the most part flat and cold, and less than half of the land is tillable.

In metals and mineral resources, the Soviet Union is considered one of the richest countries in the world. However, its resources have never been put fully to use because of great geographic impediments to transportation. Climate, technology, and availability of necessary capital among other reasons.

In population, the Soviet Union is a little larger than the United States. Its population in 1985 was 278.62 million, compared to 239.28 million for the United States. In one respect, though, the population of both countries is similar because each consists of a melange of different racial and ethnic groups (Appendix A).

Recent happenings and conditions of the Soviet economy are so much a product of the effect and results of the Russian Revolution in 1917. Lenin was reportedly impressed by the planning practices used in the United States and Imperial Germany during World War I, and looked to their experience for ideas to apply to the

Soviet Economy.[1] This technique of the "war-economy" which has been retained in the Soviet-type economies, have come to be the identity of a communist economic system of central planning, although Marx had very little to say about central planning.[2] In 1989 the USSR celebrated the 72nd anniversary of the October Revolution; the upheaval which brought the Bolsheviks to power. In this more than 70 year period, the USSR experienced a number of radically different economic systems.

War Communism (1918-21). This time was marked by widespread state ownership, the direction of labor, the attempt to administer the economy centrally. The extent to which this system was forcibly accepted by the Bolsheviks at the time of their Civil War or by the indoctrination of the Marxist teachings is quite controversial. Although this system facilitated the Bolshevik victory in the Civil War, it led to economic collapse on all fronts, with very low industrial and agricultural production (Table 1), depopulation of the towns and famine. It is remarkable how rapidly and

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[1]Harry Schwartz, An Introduction to Soviet Economy (Columbus, OH: Charles E. Merrill, 1968), p. 83.

[2]John M. Montias, Central Planning in Poland (New Haven, CN: Yale University Press, 1962), p. vii.

Table 1. Basic Industrial and Agricultural Production Figures Between 1913-1926 (USSR)

	1913	1920	1921	1922	1923	1924	1925	1926
Industrial (Factory) Production (million 1926-27 roubles)	10,251	1,410	2,004	2,619	4,005	4,660	7,739	11,083
Coal (million tons)	29.0	8.7	8.9	9.5	13.7	16.1	18.1	27.6
Electricity (million KWhs)	1,945	--	520	755	1,146	1,562	2,925	3,508
Pig Iron ('000 tons)	4,216	--	116	188	309	755	1,535	2,441
Steel ('000 tons)	4,231	--	183	392	709	1,140	2,135	3,141
Cotton fabrics (million metres)	2,582	--	105	349	691	963	1,688	2,286
Sown Areas (million ha.)	103	--	90.3	77.7	91.7	98.1	104.3	110.3
Grain Harvest (million tons)	80.1	46.1	37.6	50.3	56.6	51.4	72.5	76.8
Rail Freight Carried (million tons)	132.4	--	39.4	39.9	58.0	67.5	83.4	--

Sources: Soviet Government Statistics.

effectively the vacuum was filled and things were finally called to order and regulated in 1921 by Lenin's New Economic Policy (NEP).

New Economic Policy (NEP)

Basically, the New Economic Policy was introduced by Lenin in 1921 to encourage peasants to sell in the open market and benefit thereby, subject to a government tax on what they produced. The NEP was a mixed economy, combining a large private sector with state control of the commanding heights of the economy.[1] During the period, a majority of the population of the Soviet Union became engaged in subsistence or smallholder agriculture. Throughout the economy, production, distribution, and allocation of labor were largely left to market forces. On the other hand, large-scale industry, transport, and banking were in the hands of the state which also dominated wholesale trade and monopolized foreign trade.

It may be useful at this point periodically to indicate how economic growth was developing in the principal sectors of the economy of the USSR.

Stalin's Era. In 1929, Lenin's successor, Joseph Stalin, openly recognized that the October Revolution had

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[1]Michael Ellman, The USSR in the 1990s--Struggling Out of Stagnation, Special Report No. 1152 (London: The Economist Intelligence Unit, 1989), p, 5-6.

not sparked off the anticipated wave of international socialism[1] which should bring about international aid and recognition to Russia. In a few years of experimentation, and after undergoing a wave of economic crises in 1931-33, a fairly stable system emerged. This was referred to in the USSR and in UN publications as "Central Planning" and by some others in such derogatory terms such as "the Command Administrative System."[2]

Stalin, on taking over from Lenin, traumatized the country in the period spanning over thirty years. He intimated to Churchill that "millions of men and women [had been] blotted out or displaced forever, simply because they resisted the process of collectivization."[3] Stalin was determined to industrialize the country without regard to sentimentality or due consideration for adverse consequences. His main plan was to produce and build a solid capital industrial base. Agriculture was relegated to the back burner and together with the

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[1]Socialism is defined in Webster's Unabridged Dictionary (1979) as the stage of society coming between the capitalist stage and communist stage, in which private ownership of the means of production and distribution has been eliminated.

[2]M. S. Schnitzer, and J. N. Nordyke, Comparative Economic Systems (Chicago: Southwestern Publishing Co., 1983), pp. 403-404.

[3]Marshall Goldman, U.S.S.R. in Crisis: The Failure of an Economic System (1st ed.) (New York: Norton, 1983), p. 23.

peasantry were forced to finance the bulk of the capital needed for Stalin's industrialization process. Low prices were paid to the peasants for their agricultural products, and hence, for several years afterwards, many peasants could not make enough from the collectivized sectors to sustain themselves and their families. Upon Stalin's decision to exploit the peasants, the relationship between agriculture and industry became very strained. The peasants tried to hold back, in turn, the planning authorities in Moscow increased their control of agriculture.

According to Goldman, "This tended to make the peasant less cooperative and all the less willing to show initiative as the peasants must do to cope with the anticipated changes in the very erratic Soviet weather."[1] Not surprisingly, the agricultural potential of the country has not been realized since collectivization.

Important features of the Soviet economic system developed under Stalin include:

--Collectivization and state control of agricultural production

--Growth of Employment

--State monopoly of foreign trade

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[1]Marshall I. Goldman, U.S.S.R. in Crisis: The Failure of an Economic System (1st ed.) (New York: Norton, 1983), p. 75.

--Mostly five year plans on national level developed and further broken down into annual production plans.

--Shortages of producer and consumer goods

--Proliferation of the "black-market" where stolen goods, or goods originally purchased in the state sector, are resold at market determined prices and where production and trade in goods and services produced outside the state sector takes place.[1]

After the "central-planning" system was adopted in the USSR, it was extensively publicized throughout the world and disseminated internationally. In 1949-53, it was adopted in eastern Europe, in 1953-57 in China and subsequently in countries such as Vietnam and Cuba. It also had some influence in countries such as Germany, Mexico, France, the Netherlands and India, though in a different and not too rigid form.

The Soviet Union developed into a bureaucratic state, with no major economic plans made by state officials, planning production based on estimated needs of the system and the populace, with the populace having little or no say in the matter, but to conform to directions and regulations allotted to them. The

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[1]Michael Ellman, The USSR in the 1990s--Struggling Out of Stagnation, Special Report No. 1152 (London: The Economist Intelligence Unit, 1989), p. 8.

allocation of resources is in the hands of the planners, who must make decisions concerning what, how much, and for whom to produce, which culminated in the development of the first five-year plan as laid out in Table 2.

The figures in Table 2 are a reflection of Stalin's insistence on the expansion of heavy industry regardless of the cost to other sectors of the economy, notably agriculture. It will be noted that it contained two different versions and although it was supposed to operate with effect from October 1928, it was only approved at the Party Conference by April 1929, which also rejected the excessively optimistic first version in favor of the even less realistic "optional one."

It has been debated in many publications whether Stalin purposely, for political intentions, secured the adoption of a plan which he knew could never be realized. Table 3 shows that the target of 4.688 million rubles worth of machinery was overshot to 7.362. On the other hand, the gross agricultural production target of 25.8 billion rubles was underfulfilled, with production of 16.6. The original plans were unrealistic, and this also throws doubt even at the appropriateness of the given figures on plan's fulfillment.

In fulfillment of Stalin's ambition, the USSR experienced a rapid process of industrialization between

Table 2. First Five-Year Plan 1928-1932 (USSR)

Aggregates	1927-8 Actual	1930-3 First Version	% Increase	1932-3 "Optimal Version"	% Increase
Employed labor force (million)	11.3	14.8	30	15.8	39
Investment (all) (1926-7 prices billion rubles)	8.2	20.8	151	27.7	228
National Income (billion roubles)	8.2	44.4	82	49.7	103
Industrial Production (billion roubles) of which:	18.3	38.1	130	43.2	180
Producers' goods (billion roubles)	6.0	15.5	161	18.1	204
Consumers' goods (billion roubles)	12.3	22.6	83	25.1	103
Agricultural Production (billion roubles)	16.6	23.9	44	25.8	55
Consumption:					
Nonagricultural (index)	100.0	152.0	--	171.4	--
Agricultural population (index)	100.0	151.6	--	167.4	--
Industrial Output Targets:					
Electricity (billion KWhs)	5.0	17.0	236	22.0	335
Hard Coal (million tons)	35.4	68.0	92	75.0	111
Oil (million tons)	11.7	19.0	62	22.0	88
Iron Ore (million tons)	5.7	15.0	163	19.0	233
Pig Iron (million tons)	3.3	8.0	142	10.0	203
Steel (million tons)	4.0	8.3	107	10.4	160
Machinery (million roubles)	1,822.0	--	--	4,688.0	157
Superphosphates (million tons)	0.1	2.6	16	3.4	22
Wool Cloth (million metres)	97.0	192.0	98	270.0	178

Source: USSR Economic Handbook by Scrivener Ronald/Soviet Government Statistics.

NOTE: The Soviet statistics are quite unreliable and characterised by impregnated figures to favor political motives and intentions. Nonetheless, reasonable deductions can be attempted on basis of what is available from Soviet government sources and numerous other published figures.

Table 3. Plan Fulfillment--Important Components

	1927-8 (Actual)	1932-3 (Plan)	1932 (Actual)
National Income (Billion 1926-7 roubles)	24.4	49.7	45.5
Gross Industrial Production (Billion 1926-7 roubles)	18.3	43.2	43.3
Producers's Good (Billion 1926-7 roubles)	6.0	18.1	23.1
Consumer's Goods (Billion 1926-7 roubles)	13.1	25.8	16.6
Electricity (billion KWhs)	5.1	22.0	13.4
Hard Coal (million tons)	35.4	75.0	64.3
Oil (million tons)	11.7	22.0	21.4
Iron Ore (million tons)	5.7	19.0	12.1
Pig Iron (million tons)	3.3	10.0	6.2
Steel (million tons)	4.0	10.4	5.9
Machinery (million 1926-7 roubles)	1,822.0	4,688.0	7,362.0
Superphosphates (million tons)	0.2	3.4	0.6
Wood Cloth (million metres)	97.0	270.0	93.3
Total Employed labor force (millions)	11.3	15.8	22.8

Source: USSR Economic Handbook by Scrivener Ronald/Soviet Government Statistics.

the mid-1920's and the mid-1970's (with the exception of the war period 1942-1946). The fuel and energy, iron and steel, and engineering industries grew quickly. According to numerous publications and published figures, whereas in 1914 the USSR was the world's fifth industrial power, in the early 1960s it became the world's largest producer of basic industrial products and even in some sectors (e.g., space exploration), it became the most advanced country in the world.[1]

With regard to the distribution of the labor force, there has been a tremendous increase in the proportion in industry and services. Over the last half century, as indicated in Table 4, showing sectorial distribution of the labor force, the period between 1940-87 shows a substantial growth in the state labor force with increasing proportions engaged in industry up until 1970 which was followed by a small decline. It is quite noticeable that there occurred a continuous decline in the proportion working in agriculture and subsequent increase in proportions working in construction, trade, education, and medical care.

The indications of this continuous industrialization program over such a prolonged period of

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[1]The Soviet Union has always been self-sufficient in the field of energy. It is the world's leading gas producer and consumer, ahead of the United States.

Table 4. Sectoral Distribution of the Labor Force in the State Sector, 1940-87 (% of Total) (USSR)

Sector	1940	1960	1970	1980	1987
Industry[a]	22.1	28.0	30.1	29.8	29.0
Agriculture[b]	47.4	31.9	23.0	19.5	18.6
Forestry	0.5	0.5	0.4	0.4	0.3
Construction	3.4	7.8	8.7	9.1	9.1
Transport	5.9	7.8	7.6	8.3	8.0
Communications	0.8	0.9	1.2	1.3	1.2
Trade	5.7	5.8	7.1	7.8	8.0
Information & Computing	--	--	--	0.2	0.3
Other Productive[c]	0.3	0.6	1.0	1.1	1.3
Housing and other domestic services (e.g., laundries)	2.5	2.4	3.0	3.6	3.9
Medical care, sports & social services	2.5	4.3	4.9	5.0	5.4
Education	4.2	5.3	6.9	7.4	7.9
Culture	0.3	0.6	0.8	1.1	1.1
Art	0.3	0.4	0.4	0.4	0.4
Scientific Research	0.7	2.0	2.9	3.6	3.5
Administration	3.0	1.5	1.7	1.8	1.5[d]
Total Labor Force (mn)	59.3	80.8	104.9	123.7	131.1

SOURCE: Michael Ellman, The USSR in the 1990s--Struggling out of Stagnation, p. 10. Original figures collected from Narodnoe Khizyaistvo SSSR 3a Folet; Naradnoe Khazaistvo SSR v 1963g with few modifications based on current estimates.

[a]Includes mining.

[b]Includes collective farm sector.

[c]In Soviet national income accounting the economy is divided into "productive" and "nonproductive" sectors. The rows above this line comprise the "productive" sector, below it the "unproductive" sector.

[d]After reclassification, this category was designed to produce successes for the "reduce bureaucracy" campaign.

Table 5. Percentage Growth Comparisons for Key Sectors of the Economy (USA and USSR)

	Growth % p.a.			
	1970-80		1980-85	
	USA	USSR	USA	USSR
Agricultural Production (Aggregated)	2.3	1.1	2.3	2.1
Industrial Growth	3.3	6.0	2.7	3.7
Coal Production[a]	2.6	1.3	0.9	N.A.
Crude Oil Production	-1.1	5.5	0.7	-0.3
Petroleum Products Production[b]	2.0	5.0	-1.7	-0.3
Natural Gas Production[c]	-0.8	8.2	-3.3	8.1
Electricity Production	3.7	5.7	1.0	3.6

SOURCE: The World in Figures--A publication by the Economist, London.

NOTE: Comparing rates of growth is inevitably a tricky exercise. The problem is the selection of appropriate periods of comparison.

[a]Coal production refers to the mining of anthracite, bituminous and semibituminous coal with a gross calorific value of more than 5700 calories per gram on an ash-free and moist basis. Peat, brown coal, and lignite are generally excluded.

[b]Petroleum products production refers to crude petroleum including shale oil, but excluding natural gas liquids. Original units of volume have been converted to metric tons for comparison by use of specific gravities.

[c]Production data for natural gas refer, as far as possible, to natural gas (consisting primarily of hydrocarbons) actually collected and utilized as a fuel or as a raw material and obtained from gas fields, petroleum fields, and coal mines. Generally, the series excludes gas used to reestablish pressure in the fields, gas vented and flared, and shrinkage resulting from the removal of natural gas liquids.

time is shown in Table 5 in comparison with the USA growth of some selected sectors of the economy.

As can be seen from Table 5, using 1970 as the base year, the USSR had significantly tangible percentage growth in the production of a number of basic industrial products and raw materials, e.g., oil and natural gas (for all of which the USSR is the world's largest producer). These figures are in no way indicative of the efficiency with which these inputs are used to produce final products or the volume of consumer goods produced with them.

Economic stagnation: Crisis. Recent economic policy in the Soviet Union regarding use of resources at their disposal to forge a path toward growth can only be understood in a context of what transpired in preceding periods to this current stage. One is reminded mostly of two phenomena that were characteristic of the late 1970s and early 1980s, namely, period of economic stagnation and shortages of consumer goods.

The period of high economic growth in the 1950's, led to rapid economic development in the Soviet Union. According to many publications, this led to Khrushchev's statement at a meeting with John Kennedy, referring to surpassed growth of the USSR economy relative to the USA, and the felt need as of that time to accelerate their

economic growth so as to meet the Soviet challenge.[1] Surprisingly, however, by the late 1970's, the Soviet economy went into "recession" or what in many today term "perpetual stagnation." The indication of this stagnation or decline in growth (retardation) is set out in Figure 2, which shows the periodic changes of Soviet economic production in general between the periods 1953-1987. Soviets devoted major resources to military expenditure during the "Cold War" and this adversely affected the availability of such resources for use in other parts of the economy.

Declining economic production, such as indicated in Figure 2, means serious repercussions for the USSR. As rightly pointed out by Michael Ellman,

> macroeconomic stagnation has serious consequences for the USSR. Internally, it deprived the party-state apparatus of an important function, that of distributing surpluses . . . it turned economic policy into a zero sum game, that is into a situation in which gains for some groups were only possible at the expense of others. Externally, it meant that the USSR was no longer able to compete against other countries in economic development.[2]

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[1]Marshall Goldman, USSR in Crisis: The Failure of an Economic System (1st Ed.), (New York: Norton, 1983), p. 27.

[2]Michael Ellman, The USSR in the 1990s--Struggling Out of Stagnation, Special Report No. 1152 (London: The Economist Intelligence Unit, 1989), p. 13.

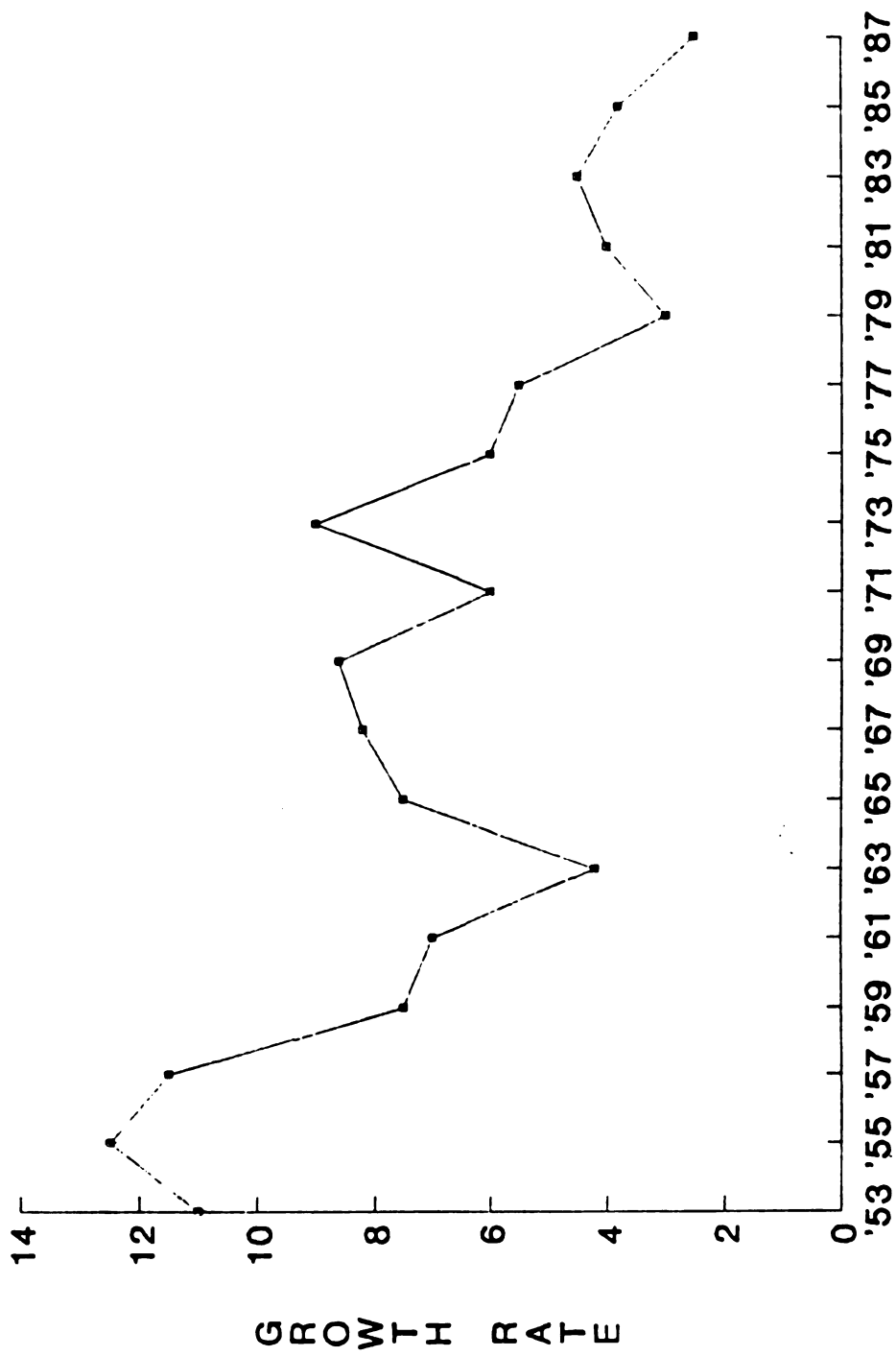

Figure 2. USSR Periodic Changes of Economic Production (% p.a.).

Source: USSR Government Statistics, Various Years.

In the 1970's and early 1980's, coupled with declining output in agricultural production, economic stagnation and reported increases in budget deficits in the USSR, there resulted an increase in shortages of vital consumer goods. Queues and shortages in the Soviet consumer reports became a "sad-music" to the ears of people. Relevantly, these shortages led to a fall in the real incomes of the population, constituting a factor in major inflationary pressures, as excess demand drove up prices and leading to a "proliferation" of the "second-economy" or "black-market," described earlier in this chapter. Hence, a decline in labor morale in the state sector set in with realization of the high incomes that is obtainable in the "black-market," relative to the declining real incomes in the state sector.

This and numerous other factors that are obviously beyond the scope of this dissertation, namely political instability, increasing environmental degradation, unstable world market, and increasing technological retardation, are very disquieting thoughts on the minds of Soviet leaders right now, and means and solutions are being sought to correct the ills that plague this gigantic economy. We shall later take a look at some of these questions posed by this dilemma in the Soviet economy for now and the near future.

The USA

There exists numerous literature on the economic history of the United States of America, which spans decades of changes in the economic structures, problems, and progresses made in the US economy. No single intelligent person can purport to combine adequately in one text or even textbook, these details. Hence, all the writers have made attempts to afford only "piecemeal" analysis of the economy as could be carried by their capabilities. It is futile trying to construct a detailed analysis of the economy of the USA or as a matter of fact any detailed economy of a nation as gigantic as the USA or USSR in a single study of this nature. But as with the case in the previous segment of this chapter, concerning the economy of the USSR, one can attempt at least to draw a picture of the developmental processes and economic growth of the USA using some objective indicators for a uniform analysis.

The economy is immensely powerful, and it offers a wide combination of results, hence it is ranked as one of the wonders of the world. As a subject for intellectual study, it is very fascinating, and it offers a fair share of complexity even when one tries to forge a description.

Any effort to comprehend the US economic system must begin with a description of its size, and the

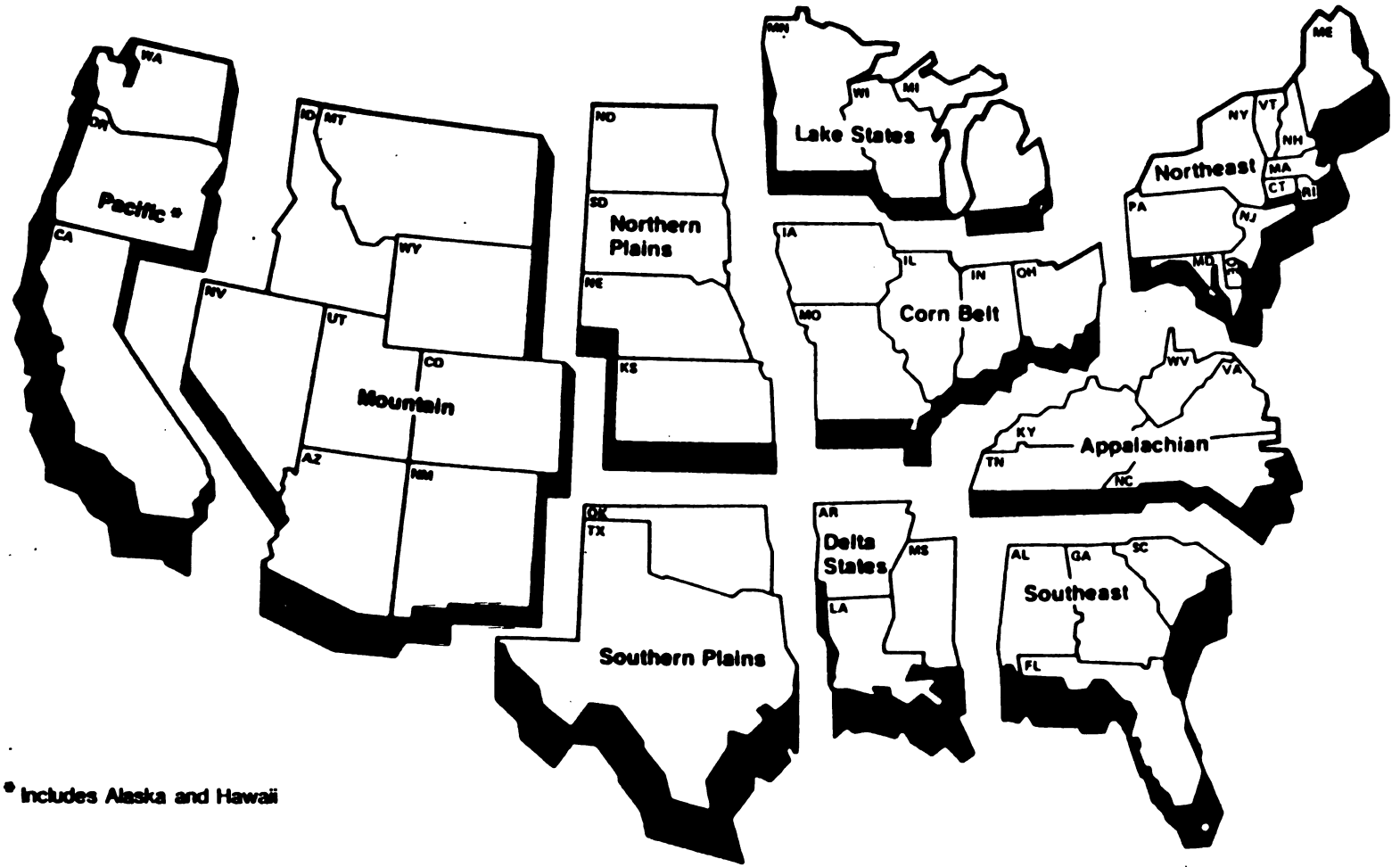

Figure 3. Farm Production Regions of the USA.

Source: USDA Economic Research Service Publication # ECIFS8-5, Apirl, 1990, p. iii.

constitution of the characters that make up its principal fabrics. It spans over an area of approximately 3.6 million square miles, about one third the size of the USSR. The North America and Pacific Ocean continental United States has Canada on the northern boundary and Mexico on the southern. Alaska is bounded to the southeast by Canada and to the west by the Soviet Union. Hawaii is in the Central Pacific (2,400 miles) to the west of the mainland.

The climate is mainly temperate; with subtropical conditions in the south. In population, the US is a little smaller than the Soviet Union. Its population in 1985 was 239.28 million compared to 278.62 million for the Soviet Union.

In the American economic system, there is primary reliance on the market mechanism to allocate resources. This mechanism has been modified and redefined over time as individuals and groups demanded for alternate results as to that obtainable under the dictates of completely "free-enterprise." For example, farmers receive protection through government subsidies, and some automobile companies negotiated acceptable quotas on influx of the products of their foreign competitors into the USA.

Such clamors have brought many changes and modifications of the market mechanisms over time so that

the results are modified from what they would be with complete "free-enterprise." Hence many authoritative sources have come to refer in numerous literature to the American economy as a modified market economy[1] in which the government plays a relatively important role than would have been called for in a total market economy.

Nonetheless, the American economy can still be said to be reliant on the market mechanism for allocating its resources for appropriate uses in the economy.

A major production and distribution decision still take place in enterprises with many direct information from the government such as obtainable in the Soviet Union. The American household still plays a basic role in the goods and services demanded and supplied, on the basis of the information available to them by mode of the pricing systems and the dictates of incomes from their labor.

Economic milestones. A good part of the 19th century saw tremendous progress in the American economic system. There was growth of the economic system, riding mostly on the back of the agricultural successes of the early settlers. The later part of the 19th century

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[1]M. C. Schnitzer and J. N. Nordyke, Comparative Economic Systems (3rd Ed.), (Cincinnati: Southwestern Publishing Co., 1983), p. 50.

witnessed rapid industrialization and by the turn of the century, the United States attained a position as undisputed world leader[1] among other leading industrial nations.

These results were achieved during the better part of this progress without much intervention from the government. With time though, as the economic situation became more complex, the larger role of the government in promoting fair play became inevitable and hence there came more government restrictions on the economic activities of individuals.

There exists tremendous economic-historical trends, detailing these step-by-step progresses in explaining this rapid development. According to Rolf Eidem and Staffan Viotti,[2] production during this period was mostly organized in a great number of competing enterprises, which were typically owned and controlled by individuals. All the enterprises had to fight for their existence and only the best ones survived, without growing so large as to be able to maneuver their competitors out of the market to stave off competition.

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[1]There is debate and different ideas about this, since Great Britain as of then or thereabout was still laying claim to being the "economic giant" of the world.

[2]Rolf Eidem, and Staffam Viott, Economic Systems--Comparative Economics (New York: Wiley, 1978), p. 17.

According to the basis of this arrangement in a production alternative that frees the enterprise of restrictive or dictates of government's total control, most Americans have shaped their ideas and accepted this strongly decentralized allocation system to be the best. The view and conviction of most as regards this notion of "free-competition," is that goods are produced better and as cheaply as possible with due consideration to consumers' tastes and preferences.

Role of Agriculture.

An abundant supply of agricultural products has contributed greatly to economic growth in the U.S. Throughout American history, agricultural output has increased more rapidly than population. Overall, productivity in agriculture has gone up rapidly, doubling in the last century. Real costs per unit of agricultural output decreased by one-half.[1]

Rising productivity in agriculture has contributed to economic development of nonagricultural sectors in several ways. It has supplied increasing amounts of food and other farm products at relatively low costs. It has freed workers for employment in nonfarm

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[1]How the United States Improved its Agriculture (Washington, D.C.: ERS Foreign--76, March, 1964), p. iii.

industries, served as a source of capital for nonfarm industries, and earned foreign exchange that helped finance imports of scarce capital goods. Also, it has provided a major market for industrial goods and services.

Expansion in land area under cultivation was a major means of increasing production up to about 1920. Overall productivity of agriculture went up gradually. After 1920, increases in production resulted from increased use of capital inputs and labor as well as some land. Foundations for later increases in agricultural productivity were built with establishment of family operated farms, free public schools, agricultural research and extension services, credit facilities, farmer cooperatives, rural electrification, and improved "farm-to-market" roads, and other transportation and communication facilities.

Agricultural output increased slowly in the 1920-1935 period.[1] Strong economic incentives for expanding farm products declined relative to those of production inputs. Total labor force on farms began to decline as many farm people transferred to nonfarm jobs.

Agricultural productivity went up rapidly beginning to the late 1930's and continuing to the

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[1]Ibid., p. iii.

present. In fact, total agricultural output has increased as much or more in the last 40 years as it did in the preceding 75 years. Higher prices and larger markets for farm products made it profitable for farmer to apply improved agricultural technology, developed through years of research. Additional capital inputs were used to improve production methods, but labor force in agriculture declined with corresponding industrial growth. Increased productivity has been and remains the source of most of the agricultural output expansion in the USA.

A look at the structure of agriculture in American economy in the past relative to recent times, as shown in Table 6, shows it as being differently structured from what it used to be in the past. This does not mean that agricultural production has fallen in any way, on the contrary, there exists numerous indications (subject of later discussion), showing an increase in output.

Industry. Industries in the United States are concentrated in the hands of a few firms and ownerships of factors of production, consequently, in a few hands. This fact is not peculiar to the USA, but it is the same

Table 6. Indicators of Agricultural Development, USA, 1920-1987

Year	Farm Population as % of Total Population	Land Area in Farms (Mil. Acres.)	No. of Farms (1000's)	Average Size of Farm (acres)	Agricultural Employment (1000's)	Index of Farm Output 1977= 100	Index of Farm Output Per Man-hour
1920	30.1	956	6,518	148	--	--	--
1930	24.9	987	6,546	151	10,340	53	28
1940	23.2	1,065	6,103	174	9,540	59	36
1950	15.3	1,161	5,389	216	7,507	61	61
1959	9.4	1,123	3,711	303	5,836	64	70
1962	7.7	--	--	--	5,190	68	85
1963	7.1	--	--	--	4,946	75	83
1965	4.3	1,061	2,543	460	4,528	83	86
1975	4.1	1,059	2,522	420	4,342	89	90
1977	3.6	1,047	2,456	427	4,169	100	100
1980	3.2	1,039	2,433	427	3,705	113	109
1982	3.0	1,027	2,400	428	4,043	133	125
1984	2.4	1,019	2,329	438	3,750	138	131
1985	2.2	1,014	2,274	446	3,570	155	139
1986	2.2	1,007	2,212	456	3,204	161	139
1987	2.0	1,003	2,159	461	3,211	--	140

SOURCES: Comparative Economic Systems by Gruchy Allan G, 1966, p. 84, and updated in Statistical Abstracts of the United States, 1988.

for most other major industrial countries regardless of the proclaimed political ideology.[1]

The changes that took place in the first half of the twentieth century, namely the mass production of automobiles, scale development and production of home appliances and the influence of the mass media, saw the concentration of American industry more fewer firms.

According to Schnitzer, size played a big role and there was a big advantage to size from the standpoint of the use of modern marketing and production methods.[2]

Wars, economic depressions and booms do not come and go as if nothing ever happened. They tend to make their effects linger around, by rearranging the way people do things and reshaping the ways in which significant policies are formulated and reformulated. They have tremendous ways of helping to restructure and reorganize economic systems and thus producing economic experiences that are quite complicated to understand, with or without references to them.

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[1]In this regard, the industrialized countries under the central-command, such as the Soviet Union, only have their governments as monopolizing all means of production and functioning as a central control.

[2]M. C. Schnitzer, and J. N. Nordyke, Comparative Economic Systems (Chicago: Southwestern Publishing Co., 1983), p. 88).

Such were the effects of the events of World War II--events of almost fifty years ago, still shaping the way things are done today. Large corporations were the producers of the fighter planes and tanks that were used by the Allied groups in the decisive victory over the Axis forces. More so the United States emerged with unsurpassed dominance of international, economic, and technological power over the rest of the world.

The 1960's and 1970's witnessed the emergence of tremendous mergers and "swallowing of the little by the big" as a representation of the coming together of the loser with the winner and the amalgamation of disparate businesses. The USA had a trade surplus in every postwar year until the early 1970s and then eventually historical redistribution of global monetary riches through the advent of the oil cartel and the subsequent energy crisis in the U.S. The net investment income eventually peaked in 1981 and until present day, the economy, though stable, still looms in muddy waters and at best, attitude towards debt and risk are uncharacterizeable, and to say the least, beyond the scope of this study.

There has been a shift in emphasis from market to political decision in the American economy in recent

years in great measures in response to increase demands from a wide variety of special interest groups.[1]

The high standard of living attained in the USA at present has been made possible by various economic events of the past, which had been continuous through high and rising level of employment. The size of the labor force is constantly expanding and there are shortages of employment opportunities. The performance of the economy in recent years have not been totally impressive. Unfortunately, the productivity of the United States has fallen to the point where it may be eventually in the position of being replaced by Japan as the world's number one economic power.[2]

There has been tremendous decreases in the growth in output per worker, by a measure of productivity. As shown in Table 7 for the period 1970-80, using 1977 as the base year, there is a slowdown in the 1970's, contributing to a deteriorating tendency in the competitiveness of American industry relative to the world economy. Hence without much saying, the primary goal of the U.S. for the near future ahead, would be to

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[1]M. C. Schnitzer, and J. N. Nordyke, Comparative Economic Systems (Southwestern Publishing Co., 1983, pp. 98-99.

[2]Ibid., p. 113.

Table 7. Indices of Production in the United States: 1970-1980 (1977 = 100)

Year	Real Output per Worker
1970	86.1
1971	89.3
1972	91.4
1973	94.4
1974	93.0
1975	84.8
1976	92.6
1977	100.0
1978	106.5
1979	110.6
1980	108.6
1981	111.0
1982	103.1
1983	109.2
1984	121.4
1985	123.7
1986	125.1
1987	129.8

Source: U.N., Department of Economic and Social Affairs Survey (New York: UN Publishing Division, 1988).

restore competence toward competitiveness through adequate designs of policies to reduce inflation, increase productivity, and strive to achieve more economic growth.

National Goals of the USSR and the USA With Regard to Agriculture and Energy Resources

It is obvious that agriculture and energy play a principal role in these economies, more in the past of the US economy relative to that of the USSR in terms of employment and general contribution. This fact will continue to hold as needs of people continue to grow in terms of food demand and production of other consumable goods.

Each national system is, at least in some respects, peculiarly distinctive and unlike any other. Each has achieved some combination of results, including those both favorable and unfavorable.

Nonetheless, economic growth, it is generally agreed, serves as the best path known to mankind to a better life. There have been numerous trials over changing times, some with relatively better successes compared to others. Questions herein posted are not to serve as fright mechanisms, but as reflections on the past so as to determine what our expectations should be into the future. We know the past, we know where we are,

and where we want to be. The key question, then, is: How do we get there from here?

During the late 1970s and early 1980s, the USSR economy experienced massive economic disequilibrium coupled with total stagnation in some aspects of the Soviet Economy. This situation is disquieting for any economy and they resulted in a whole series of adverse economic effects such as inflation, decline in productivity, inability to compete with other economic rivals and industrial nations, such as Japan and in case of the USSR, the situation was further complicated by increasing shortages in consumer goods, declines in real wages, and growth of the "black-market."

In order to accelerate economic growth and boost the living standards, the Gorbachev's regime which came to power in March 1985 is making tremendous strides to revamp the economy. The process taken, and the plans to carry out the desired changes, constitute an entire study of their own, but we will touch on a few of the policies as affects the agriculture and energy sectors. Priorities have been set and projections made regarding the different sectors over periods of planning. The new Soviet leaders under Gorbachev have consistently criticized the performance of the economy in the past by referring to the use of outdated methods of production, slack discipline, resistance to innovation and bad

management. The adverse results which are shown in Table 8, indicates that the rate of growth of real output in

Table 8. Basic Economic Growth Indicators 1976-85 (Annual % Change)

	1976-80	1981	1984
Net Material Product	4.3	3.3	3.0
Industrial Growth Output	4.5	3.4	4.2
Agricultural Growth Output	1.6	-1.0	0.0
Gross Fixed Investment	3.4	3.8	2.0
Export Value	4.8	1.9	3.1
Import Value	5.8	6.4	5.0

Source: 1985 Survey by the U.N. Department of Economic and Social Affairs

the Soviet Union had slowed from over 4% in the late 1970's to 3% in 1984. This was largely due to stagnation in agriculture and failure to reach output targets in key energy sectors. Comparative trends in the Soviet industrial production relative to that of the USA, as shown in Table 9, further attests to this. In addition, "UNCTAD" (The United Nations Conference on Trade and Development) published statistics showing how over a period of between 1960 and 1980, production of primary energy of all types (i.e., solid and liquid fuels,

Table 9. Comparative Indices of USSR and USA Industrial Production (1975 = 100)

Year	USSR	USA
1975	100	100
1976	109	112
1977	111	116
1978	116	123
1979	120	129
1980	124	125
1981	129	128
1982	132	118
1983	135	126
1984	140	140
1985	145	144

Source: Comecon Data--Edited by the Vienna Institute of Comparative Economic Studies (London: Macmillan Press Ltd., 1987), p. 36.

fuels, natural gas and hydro, but without reference to nuclear) rose in terms of million metric tons of coal equivalent in the case of the Soviet Union from 670 to 1,939; The United States from 1,414 to 2,090, and also establishing the comparative figures of the various economies in terms of billions of US dollars of Gross Domestic Product, as shown below in Table 10.

Table 10. Gross Domestic Product (Billion of US $)

	1970	1975	1985
USSR	343.4	649.0	1,212.0
USA	981.2	1,526.5	2,575.0

Source: The World in Figures--UN Economic Statistics for various years (New York: UN Publishing Division, 1987).

Generally, these pictures have spelled doom in terms of the trading positions of both the USA and USSR through the lack of their competitiveness and trends of rapidly increasing trade deficits of the US due to influx of foreign products and services which are fast overshadowing domestic efforts and leading to decline in foreign monetary reserves and balances of payments as shown in Table 11. It is thus clear that economic growth is declining in the Soviet Union and the main problem

Table 11. World Balance of Payment on Current Accounts (Billion US $)

	1981	1982	1983	1985
USA	12.8	-1.5	-33.3	-115.0
USSR	6.2	9.3	11.2	11.5

Source: The World in Figures--UN Economic Statistics for various years (New York: UN Publishing Division, 1987.

being in the energy balance, the declining availability of adequate and skilled labor in the USA and USSR and failure on the part of past leaders to secure much benefits from investments in their various grandiose programs of the past such as agriculture in USSR and auto-technology in the USA.

Both economies have vast resources to mortgage away in a variety of ways to pay out of difficulty by selling gold or continuing to borrow internationally, but in the long run, they have to come to grips with matters at home or face yet more economic chaos and falling standards of domestic living and increased dependency on external economies. For example, the terms of trade between the USA and some of their Western counterparts, such as Japan and West Germany show a drastic change in

the past recent years with the USA accumulating a huge trade imbalance.

To correct some of the deficiencies and ills, it is necessary to outline some of the policies set aside in recent years with regard to agriculture and energy development and use mainly. Some fundamental goals of the Soviet energy policy are:

--To increase nuclear electrification

--Raise petroleum production

--Increase the output of Arctic gas

--Make greater use of Siberian coal

--Increase the efficiency of energy utilization

--Introduce alternate energy technologies to meet local needs

--Arrive at an optimum mix of energy technologies to meet evolving national requirements

Frankly speaking, these goals are not in any way very different from the energy policy of the USA seeking to attain greater and more general productive efficiency.

The 27th Congress of the USSR emphasized that the goal was set in particular toward growth in subsequent decade up to the year 2000 with special attention being paid to capital investment policy and to an increase in labor productivity in 1986-1990 of between 20% and 23%. It was pointed out that without such an increase in labor productivity, the national economy would need more than

22 million additional workers, and that such resources of labor simply did not exist.[1]

The materials of the 27th Congress also further detailed the expectations in the general economies of the USSR, further attesting to central planning system, similar data for comparisons of which are not readily available in the US because supply is mostly driven by demand for the goods and services rather than compelling and complex targets.

Nonetheless, some of the details are summarized below with regard to the USSR. The plans call for guidelines to increase capital investment in the fuel and energy industries by 47% and doubling the growth rate.

Electric Output

To raise it to 1,880 billion KWh from 1,840 by 1990 inclusive of the 390 billion KWh produced by nuclear power (this was before the Chernobyl disaster of 1988).

Oil

Raise output to between 630 to 640 million tons of oil and gas condensate by developing the oil industry in Siberia, Kazakhstan, and exploring the oil field of the Caspian Depression.

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[1]Ronald Scrivener, The USSR Economic Handbook (London: Euromonitor Publications Ltd., 1987), p. 63.

Gas

Increase output by 1990 to 835-850 billion cubic meters; an increase of about 32% over the 1985 output.

Coal Industry

To increase output by 1990 to 780 to 800 million tons (1985: 725 tons) and to increase the availability of open caste mining by about 5 to 6% above current operations.[1]

There are also so much elaborate schemes of improving agricultural productivity through raising efficiency in agricultural labor use, improved agricultural equipment and mechanization; through more funding of research and development. The projections are so elaborate and hence one can only say that time will tell whether these projected production rates are going to be achieved or even closely approached. If achieved, it might or definitely will get the Soviets out of the deep slumber.

There is a renewed emphasis in the USA also on the need for the economy to grow at the maximum rate consistent with primary dependence upon free enterprise and the avoidance of market inflation, increasing

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[1]Materials of the 19th Party Conference of the Soviet Union--1988 and the 27th Congress Guidelines in 1986.

education of the citizen at all levels so as to guarantee an increased reliance on research and improved technology to provide opportunity for American industry to expand its markets. There is no consensus though as obtained in the Soviet Union, among the economists as to the growth rate those measures will produce, but conservative estimates put an expected annual increase in the gross national product at between 3-4% without extraordinary stimulating measures.

Summary--Research Question 1

The objective of this chapter in this study was to ascertain if there exists any indications that show significant disparities in the level of development in both the agricultural and energy sectors of the economies of the USSR and USA as set out in Research Question 1. Some significant disparities were identified by pointing out the numerous structural changes in the composition and role of agriculture in both economies. Over the years, agriculture has relinquished its significant role in the economy of the United States both in terms of labor employment where in 1920's more than 30% were engaged in agricultural production compared to 3-4% in present-day farm population (Table 6) and by its contribution to the economy which shows it as a declining

industry.[1] In the same measures, agriculture, though referred to as the "Achilles heel" of the Soviet economy, continues to play a significant role. It currently employs more than 20% of the total population which does not show much change dating back from the structure of the economy in the 1920's.[2] Nonetheless, productivity and growth show significant decline and stagnation for the 1970's and the 1980's (Table 5).[2]

The energy sector, on the other hand, shows that there is a larger growth in energy production in the USSR relative to the USA significantly since the 1970's (Table 5) an indication that possibly could be a response to size difference of the countries, coupled with the role of energy production and use in terms of the USSR being a major exporter of petroleum and natural gas and the USA an importer of petroleum that was hard hit by world energy events of the 1970's (referred to as an era of energy crisis in the USA).

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[1]This is a good sign in that significant rise in agricultural productivity with relative decline in farm labor usage have greatly contributed to economic development of nonagricultural sectors by helping to free workers for employment in nonfarm industries.

[2]This "ties-up" a significant proportion of the Soviet labor force that could have been useful in the development of other sectors of such developed economy. This is an example of some of the questions of misallocation of resources that was raised earlier on.

The Soviet Union has always been self-sufficient in the field of energy, and as a matter of fact it is still the world's leading gas producer and consumer, ahead of the United States. The coal reserves are immense (estimated at 195,000 million tons),[1] and electricity production has been doing well with some recent slowing down, probably due to the impact of the nuclear energy disaster at Chernobyl in April 1988. In order for the Soviets to cut down on oil consumption, oil will continue to be replaced by gas or coal in thermal power stations and same goes for the United States.

Nonetheless, we have seen from the constitution of the economies of both the USA and the USSR, the significance of these two sectors in the past and present economies, and the relative differences in the level of development attained and goals set for progress. One can then go further to see how these disparities have changed in recent years and planning periods.

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[1]Ronald Scrivener, The USSR Economic Handbook (London: Euromonitor Publications Ltd., 1987), p. 167.

CHAPTER III

RESOURCE DEVELOPMENT

Agricultural Resources

The USSR

Nature, role in economy, investment. Agriculture accounts for almost 20% of the Soviet GNP (1988), despite that only a quarter of Soviet territory is agriculturally productive. Large areas suffer from water shortages or from periodic drought.

The Soviet Union has about 2,227.5 million hectares of land area, but less than 25% is suitable for agricultural production.[1] As a result of unfavorable climatic conditions, the growing season over the 10% land area currently under cultivation is short. Only one-third of the cultivated area has adequate water supply for food and fibre production. Yet, Soviet agriculture is major, and serves to provide food for the population, raw materials for the industry, and employment for large numbers of people.

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[1]Based on the author's average estimate from figures published by USDA--Agriculture and Trade Reports on the USSR, various issues, 1980-1990.

According to Michael Ellman, the USSR has a favorable land/population ratio[1] and some of the best soil in the world, but it is still a net importer of food.[2]

In the USSR, food is produced on large "socialized" farms. There are approximately 50,000 of these farms, and they account for about three-quarters of the value of Soviet agricultural production. As of 1987, the Soviet government's released figures indicated the average sizes of the socialized farm to be about 26,000 acres, with 10,000 acres of cropland.[3] Although differences between them are now shrinking, socialist

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[1]Not a very significant or relevant ratio to this particular discussion as compared to using the acreage of cultivatable land/population ratio to better focus on the issues of available acreage for agricultural usage. Especially in the Soviet Union where a large chunk of the land mass is not suitable for agricultural production.

[2]Michael Ellman, The USSR in the 1990s--Struggling Out of Stagnation, Special Report No. 1152 (London: The Economist Intelligence Unit, 1989), p. 24.

[3]Ibid.m p. 25.

farms are technically of two types--collective[1] and state[2] (Table 12).

Soviet agriculture is obviously not independent of the political trends which emphasize direct government interest. As indicated in Table 12, the increase in mechanization is skewed as state farms benefited more at the expense of collective farms. Thus between 1970 and 1984, the number of collective farms with tractors and combine harvesters dropped from 48% to 40% and from 47% to 44%. However, on state farms, the number with combine harvesters, increased from 47% to 52% and these with tractors increased from 43% to 56% in the same time period.

Both the collective and state farms are generally diversified operations. From the author's observation, the government is known to subsidize unprofitable collectives as well as state farm, so they can meet payrolls and make investments.

Among modern-day industrialized nations, the Soviet Union stands out in its preoccupation with

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[1]Soviet Collective Farm is nominally an autonomous peasants' cooperative financed from its own budget with the members sharing the profits. Major management decisions, however, are not made by individual farms, but by the central or regional administrations.

[2]Soviet State Farm is a state-run enterprise and, in the Soviet view, is the rural equivalent of an urban factory. The workers are state employees, and their wages are paid from state funds.

Table 12. Collective Farms Compared with State Farms 1970-1984.

	Collective Farms			State Farms		
	1970	1980	1984	1970	1980	1984
Total number in '000's	33.0	25.9	26.2	15.0	21.0	22.5
Number of farmsteads in millions	14.4	12.8	12.6	--	--	--
Gross products in billions roubles at 1973 prices	42.3	41.8	46.4	29.5	44.8	49.6
Area (million hectares)	99.1	95.2	92.0	91.7	111.8	109.3
Cattle (millions)	41.7	47.9	50.7	29.1	40.1	42.2
Pigs (millions)	29.6	28.1	29.3	16.6	23.6	25.9
Sheep (millions)	53.5	45.2	44.2	53.1	68.1	68.3
Tractors ('000's)	942.0	1,057.0	1,121.0	803.0	1,191.0	1,283.0
Output in million KWh	36.8	55.9	64.8	34.6	67.0	77.3
Combine harvesters ('000's)	292.0	300.0	355.0	294.0	373.0	420.0

SOURCE: Soviet Government Statistics.

agriculture. Almost 20% of the Soviet labor force is engaged in agriculture (1986), which is a major improvement from the years after the revolution, in 1917, when more than 75% were peasants (until the 1940's with more than 48% still engaged under agriculture). This is still very high relative to the USA (Figure 4). A little above one-quarter of the investment funds of the USSR are spent in agriculture (Table 13).

Grains. As Marshall Goldman adequately stated:

> Despite the fact that in times past Russia served as the breadbasket of Europe, . . . from 1909 to 1918, before the revolution, Russian grain exports averaged 11 million metric tons a year. This amounted to 30 percent of world grain exports and made Russia the world's largest grain exporter . . . the Soviet Union in recent years not only has been unable to maintain its net exports of grain, but also has been unable to satisfy the basic food need of its own population.[1]

As most experts agree, grain production is often referred to as the "Achilles heel" of the Soviet Union. Soviet grain production in 1987 totaled a reported 211.4 million tons (bunkerweight), less than 1% above 1986, but as well noted, it is the first time in a long while when Soviet grain production in two consecutive crop year surpassed the 200 million tons mark harvested, and the national yield averaged 1.83 tons per hectare despite

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[1]Marshall I. Goldman, ed., The Soviet Economy: Myth and Reality (Englewood Cliffs, N.J.: Prentice-Hall, 1983), p. 63.

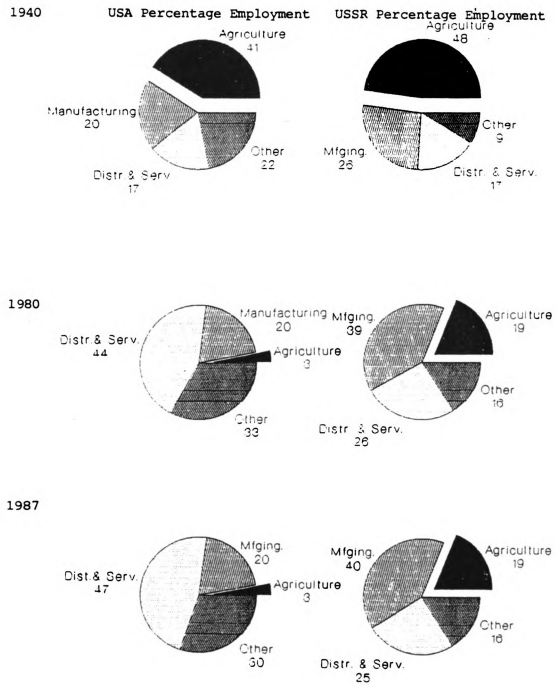

Figure 4. Distribution of Employment in USA and USSR.

Source: Table 4 and the World in Figures. Editorial Information compiled by The Economist (London: The Economist Publication, 1988).

Table 13. Share of Total Investment and Percentage Labor Force in Agriculture in USSR, 1961-1985.

	1961-65	1966-70	1971-75	1975-85
Total Investment (billion Roubles)	247.6	353.8	501.6	702.7
Agriculture Portion (billion Roubles)	48.6	82.2	131.5	220.4
% of Total	19.6	23.2	26.2	31.4
% of Labor Force in Agriculture	42.0	19.0	21.66	26.7
% GDP Accounted for by Agriculture	N.A.	17.0	N.A.	20.0

Source: The World in Figures UN Economic Statistics for various years (New York: UN PUblishing Division, 1987).

declining total grain area to 115.2 million hectares, the lowest in more than 25 years.[1] Despite the overall picture of a good grain crop production shown in Table 14, wheat production and quality were reportedly down measurably in 1987. Coarse grain production rose 7% with yield at a good 1.91 tons per hectare. Production of corn rose 19% above the dismal 1985 crop, showing the largest return in 25 years. Generally, the good performance was primarily attributable to the largest area allotted since 1965. Relative to the yield figures obtainable for the USA for a comparable period, the USSR is still lagging far behind on yield per hectare (see Figure 5 and Table 14).

The main agricultural producing regions of the USSR the north of the comparable production are of the USA. There have been theories and arguments as to that being a reason for the relatively poor yields that are obtainable in the USSR due to the unfavorable weather conditions that are attributable to this latitudinal position and relatively adverse weather conditions. Nonetheless, comparative figures for Canadian wheat yield with that of the USSR (Figure 5), indicate a better

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[1]USSR, Agriculture and Trade Reports. Situation and Outlook Series, 1987-1989, (Washington, D.C.: United States Department of Agriculture, Economic Research Service, 1989), p. 20.

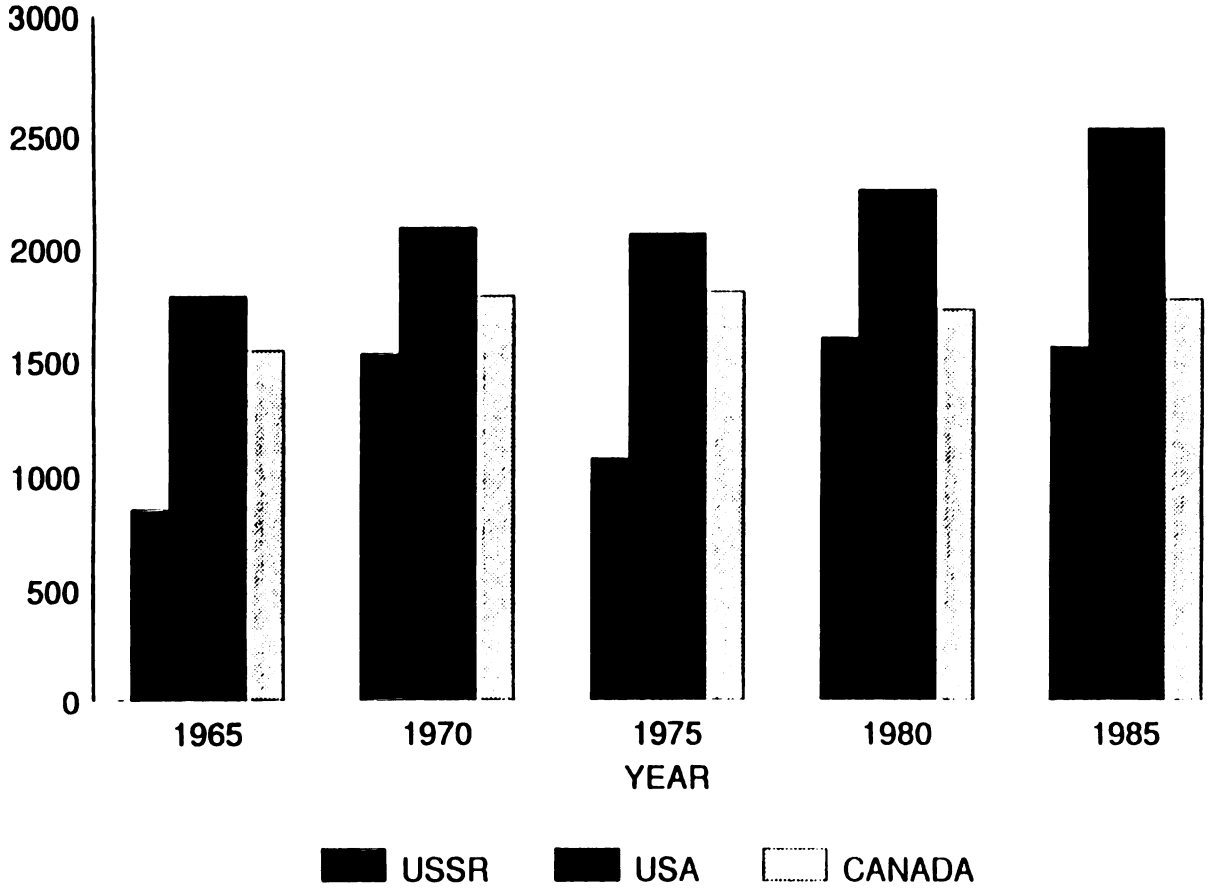

Figure 5. Comparative Yield of Wheat Production in the USSR, USA, and Canada (Kg/ha).

Source: Table 14. FAO Processed Statistics Series 1, 1988.

Table 1-1. USA and USSR: Comparison of Selected Crop Production, 1965-1985

	1965			1970		1975			1980		1985		
	USA	USSR	USSR as % of USA	USA	USSR	USA	USSR	USSR as % of USA	USA	USSR	USA	USSR	USSR as % of USA
Soybean													
Area Harv. (1000 ha)	12,461	853	7	17,097	861	21,598	811	4	27,443	854	24,922	738	3
Yield (Kg/Ha)	1,531	494	32	1,794	691	1,942	962	50	1,783	615	2,292	644	28
Production (1000 MT)	19,076	421	2	30,675	595	42,140	780	2	48,922	525	57,114	475	1.0
Wheat													
Area Harv (1000 ha)	20,056	70,205	350	17,629	65,230	28,125	61,985	220.1	28,784	61,475	26,197	50,265	191.9
Yield (Kg/ha)	1,785	850	48	2,087	1,529	2,058	1,068	51.9	2,251	1,597	2,519	1,554	61.7
Production (1000 MT)	35,805	59,686	167	36,784	99,734	57,886	66,224	114.4	64,800	98,182	66,002	78,100	118.3
Maize													
Area Harv (1000 ha)	22,416	5,114	23	23,212	3,353	26,468	2,652	10.0	29,526	2,977	30,406	4,482	14.7
Yield (Kg/ha)	4,649	2,708	58	4,544	2,812	4,512	2,763	61.2	5,712	3,176	7,406	3,213	43.4
Production (1000 MT)	104,217	13,849	13	105,471	9,428	119,420	7,328	6.1	168,647	9,454	225,180	14,400	6.4
Oats													
Area Harv (1000 ha)	7,496	6,900	92	7,525	9,250	5,276	12,107	229.5	3,503	11,770	3,309	12,664	382.7
Yield (Kg/Ha)	1,800	825	46	1,765	1,535	1,758	1,032	58.7	1,901	1,321	2,284	1,619	70.9
Production (1000 MT)	13,493	5,691	42	13,285	14,203	9,275	12,495	134.7	6,659	15,544	7,559	20,500	271.2
Millets and Sorghum													
Area Harv (1000 Ha)	5,273	3,317	63	5,491	2,730	6,233	2,851	45.7	5,064	3,005	6,747	2,995	44.4
Yield (Kg/Ha)	3,240	683	24	3,161	789	3,074	432	14.1	2,906	663	4,189	1,032	24.6
Production (1000 MT)	17,087	2,266	13	17,353	2,154	19,161	1,231	6.4	14,706	1,992	28,260	3,090	10.9

Table 14. Continued

	1965			1970		1975			1980		1985		
	USA	USSR	USSR as % of USA	USA	USSR	USA	USSR	USSR as % of USA	USA	USSR	USA	USSR	USSR as % of USA
Potatoes													
Area Harv. (1,000ha)	515	8,612	1,672	575	8,064	510	7,983	1565.3	464	6,936	550	6,432	1169.5
Yield (Kg/Ha)	21,245	10,297	48	25,681	12,002	28,654	10,149	35.4	29,575	9,663	33,356	11,351	34.0
Production (1000 MT)	10,941	88,676	810	14,774	96,783	14,605	81,022	554.8	13,737	67,023	18,331	73,009	398.3
Sunflower Seeds													
Area Harv. (1,000 ha)	21	4,870	23,190	85	4,777	481	4,045	840.9	1,490	4,353	1,151	4,053	352.1
Yield (Kg/Ha)	953	1,119	117	1,011	1,286	1,131	1,234	109.1	1,139	1,061	1,242	1,290	103.9
Production (1000 MT)	20	5,449	27,245	86	6,144	544	4,993	917.8	1,697	4,618	1,430	5,230	365.7
Cotton Seed													
Production (1000 MT)	5,522	3,454	63	3,690	3,482	2,919	4,827	165	4,056	5,879	4,789	5,510	115
Vegetable and Melon Total													
Production (1000 MT)	19,299	20,519	106	20,924	23,131	24,664	26,473	107	24,767	31,089	28,098	31,891	113
Fruits excl. Melons (1000 MT)	18,063	8,074	45	20,301	11,644	24,939	14,182	57	28,995	14,608	22,563	15,949	71
Grapes													
Area Harv (1000 Ha)	237	1,064	69	233	1,087	300	1,203	401	268	1,323	307	1,450	472
Yield (Kg/Ha)	13,313	3,499	26	15,175	3,690	13,204	4,489	34	18,939	5,026	16,565	3,961	24
Production (1000 MT)	3,155	3,723	118	3,536	4,011	3,961	54,000	136	5,076	6,650	5,085	5,744	113

Sources: FAO. Processed Statistics Series 1.

UN Statistical Yearbook (for Corresponding figures).

performance and higher average yield per hectare of cultivated wheat. The wheat producing regions of Canada are also known to lie more to the northern portion relative to the USA. Hence, one can assume that the relatively poor wheat yield obtainable in the Soviet Union cannot be entirely attributed to adverse or unfavorable weather conditions only, but also some other factors as well, such as the farm management practices, technology innovation and use.

Livestock. Soviet livestock productivity is plagued by its own problems too. The feed that go into producing livestock products and the products themselves account for almost 70% of gross agricultural output value in the Soviet Union.[1] The pattern of developments in the Soviet feed-livestock sector can throw much light on the growth of Soviet grain imports since the early 1970's.

Most of the devoted resources and investments in Soviet agriculture is due to an attempt to increase livestock production, either directly through raising livestock, producing feed, or performing other support operations.

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[1]Livestock and Poultry, Situation and Outlook Series (Washington, D.C.: USDA, Econ. Res. Serv., Report #LPS40) (February 1990), p. 25.

The main Soviet strategy of increasing livestock production has been focused on the modernization of livestock operations on both their state and collective farms. As observed by Edward Cook, a major feature of this modernization has been in the development of industrial livestock facilities, primarily for poultry and pork production.[1]

There have been mixed results attained through the Soviet modernization strategy. Most increases in livestock production have been achieved through costly increases in the number of low productivity animals.[2]

In spite of sizeable investments in the past on improved housing, machinery, and other inputs, productivity indicators in the Soviet Union are not too encouraging and they have failed to be as competitive as their Western counterparts in performance.

Production in the last 20 years has fallen behind demand. Between 1966 and 1985, meat production increased

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[1]Edward C. Cook, The Soviet Livestock Sector--Performance and Prospectus, (Washington, D.C.: Publication of the USDA, Foreign Agricultural Economic Report #235, 1988), p. 1

[2]Increases have been achieved by merely increasing the number of animal heads. Compared to the United States, the USSR produces nearly 60 percent less of beef and veal per head of cattle and nearly 70 percent less pork per hog. Livestock and Poultry, Situation and Outlook Report Series (Washington, D.C.: USDA, Econ. Res. Serv. Report #LSP 37, February, 1989), p. 16.

a meagre 2.75% annually (Table 16) and milk production by 1.5%, but despite these increases production has failed to meet the demand for livestock products such as meat, milk, and milk products. Population growth and a high income elasticity of demand for livestock products has resulted in a rate of demand increase that is greater than the increased rate of production.[1]

Major productivity gains in livestock products in 1986 were largely consolidated in 1987 with little or very modest improvements. Figures in Table 16 indicate that meat production in the USSR in 1987 increased 3%, milk 1%, and eggs 2%. Most of the increase in meat production was due to more cattle and hog slaughtered as indicated in the decreasing figures of livestock herds in 1987 and 1988 compared to 1985 figures in Table 15. Nonetheless, the share of livestock production in the "market basket" continues to grow. Production growth rates have revived in comparison with those of 1976-81, and improvement in animal productivity has resumed.

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[1]Marshall Goldman, USSR in Crisis--The Failure of an Economic System (1st ed.) (New York: Norton, 1983), p. 77.

Table 15. Livestock Numbers and Animal Units, USSR (Million Head) (1971-1988)

	1971	1976	1981	1982	1983	1984	1984 as % of 1971	1985	1986	1987	1988	1988 as % of 1985
Total Cattle	99.2	111.0	115.1	115.9	117.2	119.6	121.0	121.0	120.9	122.1	120.5	99.6
Of which Cows	39.8	41.9	43.4	43.7	43.8	43.9	110.3	43.6	42.9	42.4	42.0	97.7
Hogs	67.5	57.9	73.4	73.3	76.7	78.7	116.6	77.9	77.8	79.5	77.3	99.2
Sheep	138.0	141.4	141.6	142.4	142.2	145.3	105.2	142.9	140.8	142.2	140.5	98.3
Goats	5.4	5.7	5.9	6.1	6.3	6.5	120.4	6.3	6.5	6.5	6.5	103.2
Horses	7.4	6.4	5.6	5.6	5.6	5.7	77.0	5.8	5.8	5.9	5.9	102.0
Poultry	652.7	734.4	1,032.4	1,067.5	1,104.5	1,126.1	172.5	1,143.0	1,165.5	1,174.0	1,195.0	104.5
Total[a] Animal Units	130.5	136.5	149.4	150.8	153.4	156.3	120.0	157.0	156.9	158.3	156.8	99.8

[a]In terms of cows, conversion ratios as follows: Cattle (other than cows) 0.6; hogs 0.3; sheep and goats 0.1; horses 1.0; and poultry 0.02.

Source: The World in Figures--UN Economic Statistics for various years (New York: UN Publishing Division, 1979 (Percent calculations for comparison).

Table 16. Productions of Selected Livestock Products USSR ('000 Metric Tons) (1966-1987).

Table 16. Productions of Selected Livestock Products USSR ('000 Metric Tons) (1966-1987).

	1966-1970 (Avg.)	1971-1975 (Avg.)	1976-1980 (Avg.)	1981	1982	1983	1984	1985	1986	1987
Total Meat	11,583	14,004	14,843	15,199	15,368	16,449	16,985	17,131	18,057	18,600
Of which										
Beef & Veal	5,187	5,985	6,827	6,627	6,618	7,011	7,244	7,370	7,840	8,200
Pork	4,327	5,394	5,009	5,220	5,273	5,760	5,927	5,853	6,065	6,200
Mutton, Lamb Goat	992	972	882	846	816	837	866	827	894	890
Poultry	853	1,335	1,835	2,255	2,425	2,596	2,686	2,816	2,988	3,050
Other	224	318	290	251	236	245	262	265	270	260
Milk	80,553	87,446	92,662	88,874	91,044	96,463	97,906	98,608	102,173	103,400
Wool	N.A.	425	442	460	452	462	465	447	469	455
Eggs (millions)	35,840	51,427	63,133	70,855	72,409	75,110	76,482	77,255	80,746	82,100

SOURCES: The World in Figures--UN Economic Statistics for various years (New York: UN Publishing Division, 1989).

However, production cost is known and estimated to be on an increase.[1]

As can be seen,

> improvement in the Soviet livestock sector was particularly strong in 1986-87. This recent upturn coincided with General Secretary Gorbachev's emphasis on implementing economic reform in agriculture.[2]

The USA

Abundant supply of agricultural products has contributed greatly to economic growth in the United States. All through the history of the USA, increases in agricultural output has been known to be greater than comparative figures of population increases. Overall productivity in agriculture has gone up rapidly.

Rising productivity in agriculture has contributed to economic development of nonagricultural sectors in several ways. It has supplied increasing amounts of food and other farm products at relatively low costs. It has been known to free workers for employment in nonfarm industries, served as a source of capital for

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[1]"Livestock and Poultry," Situation and Outlook Series (Washington, D.C.: USDA Econ. Res. Serv., Report #LPS 40, February 1990), p. 28).

[2]Edward C. Cook, The Soviet Livestock Sector--Performance and Prospects, (Washington, D.C.: Publication of the USDA, Foreign Agricultural Economic Report #235, 1988), p. 3

nonfarm industries, and earned foreign exchange that helped finance imports of scarce capital goods. Also, it has provided major markets for industrial goods and services.[1]

Numerous interrelated factors have contributed to the large output and high productivity of American agriculture. They include:

1. Large supply of land and water resources
2. Large investments for education that improve human skills and managerial abilities
3. Development and diffusion of new knowledge about agricultural technology
4. Complementary industrial development that supplies capital inputs for agriculture
5. A structural organization of farm production and marketing that provides powerful economic incentives for farmers and marketing firms to increase output and productivity
6. Public and private complementary institutional services[2]

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[1]"How the United States Improved Its Agriculture," USDA Publication (Washington, D.C.: Econ. Res. Div., Report #ERS Foreign 76, March 1964), pp. iii-iv.

[2]Ibid., p. v.

In order to explain some of the changes in U.S. agricultural system, it is necessary to understand the structure of some selective major agricultural products in recent times, as pertain to both the crop production and livestock sectors.

Corn. Corn is the leading U.S. crop, both in volume and in value. In 1987, farmers planted about 65 million acres in corn, accounting for about 22 percent of the 304 million acres planted to principal crops. About 90 percent of the acreage was harvested for grain and the balance for silage and forage, or abandoned. With an average yield of 119.4 bushels per acre, U.S. corn production for grain reached 7.1 billion bushels in 1987.[1]

Corn, soybeans, and cotton compete for the same land in various areas of the country. The primary demand of corn and soybeans is derived from the market for livestock products here and abroad. Corn is the most important grain used in feed rations. In the 1987 crop year, corn accounted for 77 percent of all grains fed to

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[1]Stephanie Mercier, Background for 1990 Farm Legislation (Washington, D.C.: USDA Publication, Econ., Res. Serv. September 1989), p. 1.

livestock. Corn programs have substantial effect on the livestock sectors.[1]

Total U.S. corn production has trended upward since the 1930's. Production has more than doubled since 1965, peaking at 8.9 billion bushels in 1985. Year-to-year fluctuations in production occur, however, because of such factors as the weather and federal policies. Drought in 1988 for example, reduced production by more than 30 percent from previous years.[2]

Harvested acreage has remained fairly constant indicating that increased yields are responsible for most of the gains in corn production. The general increase in yields over time is due mainly to changes in technology and production practices, including development of improved high yielding hybrid varieties, increased rates of fertilization, increased irrigation, higher seeding rates, improved control of weeds, insects, and disease, and diversion of less productive acreage.

The number of farms growing corn declined from 1.5 million in 1964 to 713,700 in 1982, while the average acreage harvested rose form 39 to 100 acres per farm. The 21 largest corn-producing states (mostly the

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[1]Ibid., p. 3.

[2]Ibid., p. 2.

cornbelts of the Midwest, the Southeastern States, the Delta States, Pacific and Southern Plains (see Figure 3)) accounted for nearly 84 percent of the farm growing corn in that year. The farms growing corn averaged more than 240 acres of cropland. Farms with 500 acres of cropland or more accounted for 15.6 percent of farms growing corn but 45 percent of corn production.[1]

Wheat. Wheat is the third leading field crop produced in the United States in terms of value of production. Only corn and soybeans are more important.[2]

According to a USDA report, about 383,000 farms harvested wheat. On average, these farms harvested 142 acres of wheat. About 17 percent of these farms harvested 250 or more acres of wheat, while 65 percent harvested less than 100 acres, indicating that wheat is often a supplementary enterprise.[3]

Of the farms producing wheat in 1978, 80 percent were located in the 16 leading wheat-producing states.

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[1]Ibid., pp. 3-4.

[2]"Wheat--Background for 1985 Farm Legislation" (Washington, D.C.: USDA Publication, Econ. Res. Serv., Agriculture Information Bulletin #467, September 1984), p. 1.

[3]The wheat program would not be as important to a farmer for whom wheat is a supplementary crop as it would be a farmer for whom wheat is the main enterprise. Ibid., p. 2.

Farms with 500 acres of cropland or more accounted for 35 percent of wheat farms; those with less than 100 acres accounted for about 15 percent.

Soybeans. The soybean industry is one of the fastest growing agricultural sectors. Domestic production increased more than 300 percent during the last 25 years. Soybeans are second only to corn in production value in the United States.[1] It is a main source of protein for non-ruminants.

The importance of soybeans in the United States declined during the 1980's. U.S. dominance of world exports eroded as well. Soybean acreage dropped about 20 percent between 1979 (71.4 million acres) and 1987 (57.4 million acres).[2] Production declined by a smaller percentage because of higher average yields. Much of the growth in U.S. soybean use has come from export demand.

The downward trend in U.S. Soybean acreage (Table 14 reversed in 1988. Continued short supplies, high prices, and production incentive provisions in the Disaster Assistance Act of 1988 contributed to an

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[1]"Soybeans--Background for 1990 Farm Legislation" (Washington, D.C.: USDA Publication, Econ. Res. Serv., Agricultural Information Bulletin, September, 1989), p. 1.

[2]Ibid., p. 2.

expansion in 1989 soybean production, with planted acreage reaching 60.5 million acres.[1]

The number and size of U.S. soybean farms varies among farm production regions. Farms with fewer than 100 harvested acres of soybean accounted for 62 percent of the 511,000 soybean farms in 1982, ranging from 39 percent of the farms in the Delta to 75 percent of the farms in the Appalachia. The average harvested soybean acreage per farm increased from 114 acres to 127 acres from 1978 to 1982.[2]

Cotton. Cotton is the single most important textile fiber in the world, accounting for about 67 percent of all fibers used. Cotton in grown in about 75 countries. China, the Soviet Union, and the United States account for about 60 percent of world production.[3] During 1986-88, the United States produced about 20 percent of the world's cotton and used 10 percent. Cotton has been a major cash crop and an important source

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[1]Ibid., pp. 1-4.

[2]Ibid., p. 2.

[3]Harold Stutts, et al., "Cotton--Background for 1990 Farm Legislation" (Washington, D.C.: USDA Publication, Econ. Res. Serv., September 1989), p. 2.

of foreign exchange in the United States for nearly 200 years.[1]

In 1982, cotton ranked fifth among the major field crops in value of U.S. farm production, following corn, soybeans, wheat, and harvested hay. Cotton lint is used chiefly in clothing and home furnishings, with lesser amounts used in industrial products. The seeds are crushed for oil and the remaining meal is fed to livestock as a protein meal.[2]

Cotton is currently produced in 17 states from California to Virginia, with major concentrations in the Delta areas of Mississippi, Arkansas, and Louisiana; the Texas High Plains and Rolling Plains; Central Arizona, and the San Joaquin Valley of California. Soils, topography, elevation, temperature, and water availability are important determinants of where and how well cotton can be produced.[3]

Cotton acreage in the United States increased from less than 8 million acres at the end of the Civil War to more than 44 million acres in the mid-1920's. Production over that period ranged from about 2 million bales in 1866 to about 18 million bales in 1926. Cotton

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[1]Ibid., p. 18.

[2]Ibid., p. 2.

[3]Ibid., p. 3.

yields averaged about 180 pounds per harvested acre and rarely exceeded 200 pounds during the 1866-1930 period.[1]

From 1930 to the mid-1960's, acreage trended down, but yields moved upward. Yields increased from 268 pounds per harvested acre in 1950 to 527 pounds in 1965, about 4.5 percent per year. Since 1965, yields have shown considerable fluctuation, but no obvious trend until the 1980's, when average yield began to climb. While various government programs and prices of cotton and competing crops have influenced acreage, weather has been the chief determinant of year-to-year variability in yields. U.S. production has averaged more than 12 million bales year during the past decade, fluctuating from a low of 7.8 million bales in 1983 to a high of 15.6 million bales in 1981.[2]

Dairy. Dairy products account for about 13 percent of total cash receipts from all farm commodities. Although milk is produced and processed in every state, over half of total 1988 U.S. milk production came from Wisconsin, California, New York, Minnesota, and

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[1]Ibid.

[2]Ibid., pp. 4-5.

Pennsylvania. Over two-thirds of the total milk supply was produced in 10 states.[1]

The number of farms with milk cows declined from 2.8 million in 1955 to about 205,000 in 1989. The number of milk cows declined from 21 million in 1955 to 11.1 million in 1975, and 10.1 million in 1989. A 144 percent increase in milk production per cow enabled production to more than keep pace with commercial needs over the 1955 to 1989 period.[2]

The size distribution of dairy farms has changed over the last three decades. In 1959, 86 percent of the farms with milk cows had fewer than 20 cows. By 1987, only 33 percent fell in this category and they had only 3 percent of the milk cows. In contrast, only 7,172 farms (0.4 percent) had 100 or more cows in 1959, but in 1987, about 10 percent of the herds were in this category and had 42 percent of the milk cows. The average herd size[3]

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[1]Richard F. Fallert et al., "Dairy--Background or 1990 Farm Legislation" (Washington, D.C.: USDA Publication, Econ. Res. Serv., March 1990), p. 2.

[2]Ibid., p. 3.

[3]Herd size reflects only the size of the dairy enterprise, not the size of the whole farm's operation.

on all farms with milk cows was 50 in 1987. The average herd size on farms with five or more cows was 63.[1]

Broiler industry. The broiler[2] industry is a dynamic segment of U.S. agriculture. Production increased from 34 million head in 1934 to more than five billion head in 1987, passing the four billion mark in 1981.[3] Advances in production technologies through genetic research, equipment development, improved nutrition, and better management practices enabled the industry to produce meat faster with less feed. A 3.5 to 4.5 pound broiler can now be produced in 7 to 8 weeks, in sharp contrast to 12 to 14 weeks 40 years ago.[4]

Although new technologies are still being developed, their potential effect on the broiler industry is likely to be less dramatic than those of the past 30 years. The most promising development appear to be the use of poultry waste as a feed product, new equipment to

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[1]Richard F. Fallert et al., "Dairy--Background or 1990 Farm Legislation" (Washington, D.C.: USDA Publication, Econ. Res. Serv., March 1990), p. 2.

[2]Young chicken produced for meat. Broilers usually are 3-5 pounds liveweight and 6-8 weeks old. The terms broilers, fryers, and young chickens are interchangeable.

[3]Floyd A. Lasley et al. "The U.S. Broiler Industry" (Washington, D.C.: USDA Publication, Econ. Res. Serv., Research Report #591, November 1988), p. 7.

[4]Ibid., p. 9.

conserve energy, better meat preserving methods, genetic improvement, and more effective disease control techniques.[1]

The major production areas are northwestern Arkansas, northern Georgia and Alabama, central Mississippi, eastern Texas, the Delmarya (Delaware, Maryland, and Virginia) Peninsula, Virginia's Shenandoah Valley, North Carolina, and central California.

The numbers of U.S. farms producing broiler and other meat-type chickens dropped from 42,185 in 1959 to 32,348 in 1969, and then declined more slowly to 30,100 farms in 1982.[2] Poultry farms are becoming more specialized and production more concentrated. The 19,158 farms selling more than 16,000 birds per year in 1982 sold virtually all the broilers. Of these farms, the 13,214 in the sales group of 100,000 birds and over captured 89 percent of the total sales, averaging 237,000 birds, or 500 tons liveweight, per farm. Although the total number of farms selling broilers has declined since 1959, the number of farms producing at a commercial level has increased. Farms raising at least 100,000 birds

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[1]Ibid., p. 10.

[2]Floyd A. Lasley, et al., "The U.S. Broiler Industry" (Washington, D.C.: USDA Publication, Econ. Res. Serv., Research Report #591, November 1988), p. 7.

increased from 2,254 in 1959 to 7,634 in 1969, and to 13,214 in 1982.[1]

Comparing the USA and USSR

Soviet livestock production is centered around two principal types of producers: the state and collective farms and the small-scale household or private operators. Although there has been enormous investment in the livestock sectors of the state and collective farms over the years, and account for almost 70% of Soviet livestock production, the returns on the investments have been poor relative to their Western counterparts.[2]

In the context of enormous resource availability and the continued large share of labor in agriculture, the Soviets have constantly pursued the extensive system (numbers of animals vs. productivity per animal unit) as their growth strategy, which is very varied from that obtainable in the intensive system employed by most Western countries, U.S. inclusive.

The failure of livestock productivity to respond to the large investments has been a key factor behind the

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[1]Ibid., p. 18.

[2]Edward C. Cook, The Soviet Livestock Sector--Performance and Prospect (Washington, D.C.: Publication of the USDA, Foreign Agricultural Economic Report #235, 1988), p. 5.

rapid growth in Soviet livestock production cost since 1965.[1] Soviet livestock productivity is largely plagued by problems in feed quality,[2] solution of which has evaded the Soviet agricultural scientists and policy makers for several years.

There are a number of similarities and differences in the U.S. and Soviet livestock sectors. They both have vast livestock holdings, with Soviet inventories of cattle and hog exceeding that of the United States since 1971 on the average as shown in Figure 6.

In their composition of livestock production, both the USA and USSR produce beef more than any other type of meat, followed by pork, and thirdly poultry with the highest growth rate in recent times as shown in Table 17. The USSR is first in world milk and egg production in quantity produced, followed by the United States.

As earlier stated, the Soviet socialized sector which consists of the state and collective farms are responsible for almost 70% of Soviet livestock production

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[1]Ibid., p. 3.

[2]By a measure of the percentage of protein and other necessary concentrated additives in animal rations. Investment in storage and processing procedure can help to steadily increase the feed quality.

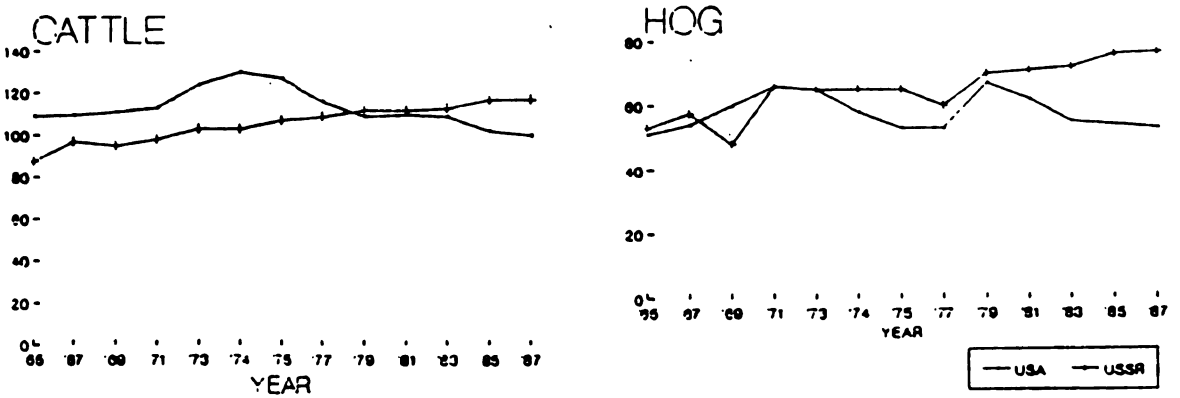

Figure 6. Recent Inventories in Cattle and Hog in the USA and USSR ('000 Head).

Source: FAO Processed Statistics Series 1, 1988.

Table 17. Production of Selected Livestock Products by Sector, USSR--1985 (%)

Sector	Pork	Beef	Milk	Poultry/ Meat	Eggs
Socialized Sector	65.0	83.3	77.1	65.0	71.9
(Industrialized Complexes)	(19.5)	(4.7)	(4.8)	(57.2)	(62.6)
(Other Farms)	(45.5)	(78.6)	(72.3)	(7.8)	(9.3)
Private Plots	35.0	16.7	22.9	35.0	28.1

Source: Edward C. Cook, The Soviet Livestock Sector--Performance and Prospects (1988), p. 11.

with the remaining 30% coming from private-plot livestock producers or households as shown in Table 17.

Soviets have invested billions of "new rubles" in livestock housing and equipment, almost 4% of total economic investment since 1965, and this does not include investment in feed production and other activities related to livestock production. Figures in Tables 19 indicate that officially significant progress is being made in the effort to increase the level of mechanization.

State farms are known to benefit more at the expense of collective farms in procurement of much needed farm inputs for major agricultural production. Figures in Table 19 show the degree of mechanization of

Table 18. USA and USSR Comparison of Selected Livestock Production and Per Capita Figures ('000 metric tons)

	1965		USSR as % of USA 1965	1970		1975		USSR as % of USA 1975	1980		1985		USSR as % of USA 1985
	USA	USSR		USA	USSR	USA	USSR		USA	USSR	USA	USSR	
Meat Total	18,543	9,956	54.0	20,606	10,830	21,816	15,060	68.9	24,614	15,094	26,123	17,131	66.0
Per Capita*	0.09	0.04	45.0	0.10	0.05	0.11	0.06	60.0	0.11	0.06	0.11	.06	55.0
Milk	56,324	75,992	135.0	53,073	83,000	52,429	90,700	173.0	58,298	90,805	65,166	98,608	151.0
Per Capita*	0.28	0.32	115	0.26	0.34	.25	.36	144	.21	.34	0.27	0.35	130.0
Hen Eggs (Mil)	3,876	1,596	41.0	4,038	2,245	3,813	3,176	83.0	4,127	3,749	4,042	4,332	107.0
Per Capita (Units)	194	68	35.0	161	92	177	124	70	181	141	169	155	92.0
Wool	109	357	327.5	85	419	54	433	800.0	48	443	40	447	118.0

[a]In metric tons.

Sources: FAO Processed Statistics Series 1.

UN Statistical Yearbook 1986.

Table 19. Degree of Mechanization of Livestock Operations in the State and Collective Farms of the USSR (%) 1970-1985.

Operation	1970	1975	1980	1985
Cow Milking	56	73	90	94
Feeding:				
Cattle	12	29	45	58
Hogs	28	60	66	74
Poultry	38	73	85	91
Watering:				
Cattle	68	81	89	92
Hogs	81	95	94	96
Poultry	77	94	95	96
Stall Cleaning:				
Cattle	30	56	75	94
Hogs	42	80	86	93
Poultry	38	78	86	91
"Complex" Mechanization[a]				
Cattle	9	25	42	56
Hogs	23	56	63	72
Poultry	23	59	72	84

[a]Combination production and processing operations.

Source: Narodnoe Khazyaistvo SSSR, Soviet Government Publication, Moscow, USSR various years.

livestock operations on Soviet farms. The state and collective farms are either almost fully mechanized with few still operating the traditional mode of farming, and are less specialized and with most of the operations unmechanized. A noted Soviet academician stated that:

> Soviet farms are plagued by the low quality of installed machinery, an inappropriate mix of available machinery. A shortage of spare parts for repair, poor quality of supplied feeds and an irregular supply of electricity from the state power network.[1]

Much of American mechanization and relative investment figures are difficult to unravel from the extant materials. The difficulty lies partly in the immense regional differences, the complex technology, and the vast number of enterprises involved in the various aspects of livestock production. Accompanying this is a lack of coordinated data. There exist numerous farm documents on regional production data and reports of various states and of the U.S. government.

Americans are more into highly mechanized system livestock production with an almost 100% mechanized procedure. U.S. farmers have over a long period of time tinkered with implements and equipment relative to their Soviet counterparts.

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[1]Shmelyov Nikolai, Perestroika as Seen by an Economist, (Novosti Press Agency Pub., 1989), p. 21.

Overall, because of the organizational structure of Soviet agriculture, which is so different from that of the United States, one should not expect to find any resemblance in the investment profiles. The Soviet pattern is almost the exact opposite of the United States.

The United States possesses great agricultural reserves in human and natural resources, knowledge machinery, and other capital. These are used by American farmers to satisfy their immediate needs most efficiently, and at times they remain unused. For example, on an American farm, it is not uncommon to find tractors and different types of machinery which may stand idle during parts of the year. But they can be and are mobilized at peak periods of production and when extra efforts are required. The same is true of land. Over the last few decades a considerable amount of land has been taken out of production in the United States because farmers are paid by the government to idle land and also more is produced on less land, concentrating their efforts on the most productive land with increased use of farm machinery. If the demand warrants, much of this unused land can be quickly brought into production.

Due to the system of private farming in the U.S., the major share of agricultural investment is carried out

by the farmers themselves, and hence, they always seek to maximize returns on their own and borrowed funds.

In the Soviet Union, however, agricultural production, like all production, is planned by the government. Goals are established in physical terms--so many tons of this and so many tons of that--and these plans have to be taken as the major component of the "demand" of the economy for agricultural products. Thus the measure of success of Soviet agriculture is its ability to fulfill government plans. The fact of the matter is that Soviet agriculture often does not fulfill the goals set for it. For example, according to official Soviet figures, meat production goals that were planned to result in increase in several million metric tons, usually produced a minute increase in thousands of tons which is not due mainly to increased productivity per animal head, but in reality to actual increases in the number of animals as a whole. Since the late 1950s, Soviet agriculture has consistently failed to meet planned production goals for almost all commodities.

According to CIA estimates, approximately 75% of the money invested in American agriculture outside of land is used for increasing the stock of machinery. In the Soviet Union, the comparable figure is about 50%. At the same time, about 40% of Soviet agricultural

construction, compared to only about 25% directed to construction in the United States.[1]

According to Goldman,[2] because of the passion of the Soviets for major construction efforts, Soviet planners tend to ignore more specific needs such as barns and auxiliary facilities on the farm. In confirmation, during the author's stay in Odessa, Ukraine between 1979-1985, the absence of barn-like shelters on Soviet farms were quite noticeable in direct contrast to what one finds on American farms.

Generally speaking, it is interesting to note that while grain production has been inadequate in the Soviet Union, meat and livestock production over the same period of time has been relatively more successful. As was mentioned earlier, increases in livestock production resulted from a determined effort to "industrialize" production in several livestock sectors. This raises the interesting question of why similar determined efforts were not used in other agricultural sectors. Some authors have advanced the explanation that the large share of labor that remain in agriculture has made it

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[1]Marshall I. Goldman, U.S.S.R. in Crisis: The Failure of an Economic System, 1st ed. (New York: Norton, 1983), pp. 79-81.

[2]Ibid., p. 92.

appropriate to allow those sectors that can absorb a large amount of labor (i.e., grain production) to continue to do so because of the absence of alternative nonagricultural work opportunities.[1] This strategy differs significantly from the emphasis since World War II in most Western economies.

The government has since recognized problems in agricultural production, but the attempted solutions put too much emphasis on addressing natural or climatic variables. For instance, over 1971-80, a large amount of money was devoted especially to irrigation and water control, unfortunately with poor results. By 1985, salinization and bog formation had claimed 30% of this irrigated land.[2] Perhaps due to improper planning, foresight and management, with this poor return on investments and high percentage of labor usage, Soviet agricultural production costs and use of the enormous resources have continued to soar.

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[1]USSR, Agriculture and Trade Reports. Situation and Outlook Series (Washington, D.C.: USDA Publication, Econ. Res. Serv., Report #RS88-2, May 1988), pp. 13-15.

[2]Ibid., p. 17.

Fuel and Energy Resources

The USSR

There is a considerable amount of energy reserves and resources in the Soviet Union. The Soviet Union is the world's largest producer of oil and the second largest producer of fuels and energy in the world today (the largest is the United States).

"Energy, along with other abundant natural resources, has historically been an important component of the material foundation of Soviet economic, political, and military power."[1] Energy in the Soviet Union is very abundant relative to other natural resource endowments. Soviet planners have been able to meet the expanding domestic needs and also generate considerable exports of oil and natural gas.

> The Soviet economic system excels in the production of energy supplies. Energy includes commodities that Soviet Central planning can control with relative ease. They are produced in bulk, are relatively homogeneous, and are easy to count. Furthermore, they are key inputs into the entire industrial process and are easy to sell on world markets in exchange for manufactured goods which the system finds it more difficult to produce.[2]

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[1]Ed. A. Hewett, Energy, Economics, and Foreign Policy in the Soviet Union (Washington, D.C.: The Brookings Institution, 1984), p. 1.

[2]Ibid., p. 24.

Table 20. Average Annual Growth Rate of Energy Production and Consumption and Net Trade in the Soviet Union for Selected Periods (1961-82).

	1961-70	1971-75	1976-82	1961-82
Energy Production	5.7	5.0	3.5	4.8
Energy Consumption	5.1	4.6	3.0	4.4
Net Export	12.0	5.7	6.7	8.9

Sources: Narodnoe Khozyaistvo SSSR, Soviet Government Publication, Moscow, USSR, various years.

Special attention has always been paid to the development and improvement of the energy economy in the Soviet Union.

The Soviet economy today is structured basically the way it was structured by Joseph Stalin a half-century ago, geared toward industrialization through central command, and hence the Soviet energy sector are key inputs into the entire industrial process thus designed. The country has a powerful fuel and energy complex, accounting for nearly one-fifth of world production of fuel and energy resources with a high average growth rate. The energy economy of the Soviet Union is based on its own fuel and energy resources. In fact, the Soviet Union is a net exporter of energy. It ranks first in the

world as a producer of coal and oil, and second as a producer of natural gas and electricity. Production figures are set out in Table 21.

The Soviet policy for the development of the fuel and energy complex are outlined in five-year plans and long-term comprehensive forecasts covering ten to twenty years at a time, details of which are worked out by state planning and economic agencies in collaboration with the scientific institutions of the USSR Academy of Sciences.

Apart from the development of various traditional types of fuel (oil, coal, natural gas, nuclear energy, shales, hydro-energy, etc.), there is a growing contribution of alternative sources of energy sources such as solar and geothermal, to the Soviet fuel and energy balance.

Most of Soviet exports of energy are to countries of the COMECON, and to some industrially developed Western countries (e.g., France, Finland, West Germany) and some developing countries (Cuba, Nicaragua, and Nambia). Production figures for the energy sector of the USSR are presented in Table 21 with estimates of the average annual percentage growth rates.

In recent years, the fuel and energy complex of the USSR has come a full circle in development. There has been tremendous improvement, owning primarily to the advent of some imported Western technology. This is

Table 21. Energy Production (USSR) (1970-1986).

	1970	1975	1980	1982	1983	1984	1985	1986	Growth % (p.a.)			
									1970-1975	1975-1980	1980-1985	1985-1990
Total Energy (000 TOE)[a]	1,216,439	1,577,712	1,937,881	2,020,742	2,068,811	2,131,496	n.a.	--	4.8	5.3	4.2	2.4
Coal	432,715	484,675	492,920	488,022	486,812	482,297	494,000	489,418	1.3	2.3	0.3	0.0
Lignite	169,045	194,716	197,440	194,935	188,164	184,305	183,500	182,698	1.6	2.9	0.3	-1.2
Crude Oil	353,039	490,801	603,207	612,551	616,343	612,678	595,048	578,925	5.5	6.8	4.2	-0.3
Petroleum products	267,906	375,171	436,588	450,700	451,200	450,200	n.a.	484,710	5.0	7.0	3.1	0.8
Natural gas (mn m^3)	197,945	289,268	435,217	502,000	535,700	587,400	643,000	702,862	8.2	7.9	8.5	8.1
Manufactured Gas (mn m^3)	32,899	36,067	36,400	36,800	36,500	36,500	36,500	35,900	1.0	1.9	0.2	0.1
Electricity (mn KWh)	740,926	1,038,607	1,293,978	1,367,000	1,419,099	1,493,000	1,545,000	158,880	5.7	7.0	4.5	3.6
of which hydro (mn KWh)	124,377	125,987	183,889	174,677	180,362	202,800	n.a.	n.a.	4.0	0.2	7.9	2.5
nuclear (mn KWh)	3,696	20,205	60,000	84,500	109,795	142,000	n.a.	n.a.	32.1	40.4	24.3	24.0

SOURCE: The World in Figures (The Economist) and 1986 Energy Statistics Yearbook.

[a]Ton of oil equivalent is defined as 10^7KCal. .848 tons of oil equivalent = 3,412 BTU per kilowatt hour.

evident above all in the improvement of all phases of primary fuel and energy resource development.

Due to the discovery and development of rich oil and gas deposits, the share of oil and gas in the structure of production of energy resources in the USSR as shown in Table 22, has increased tremendously,

Table 22. Percentage Change in the Mix of Primary Energy (1960-1987) (USSR)

	1960	1970	1975	1978	1980	1985	1986/7
	In Percent						
Oil	30.2	35.5	44.2	45.0	46.4	48.5	50.1
Gas	7.8	15.3	21.6	24.3	30.1	32.6	33.6
Coal	53.4	42.2	29.7	26.8	18.9	15.2	13.0
Peat[a]	2.9	1.7	1.2	0.5	n.a.	n.a.	n.a.
Hydropower	1.0	1.0	1.1	1.4	1.8	2.2	2.8
Other	4.7	4.3	2.2	2.0	2.4	1.5	0.5

[a]Refers to partly decayed moisture absorbing plant matter found in ancient bogs and swamps, used as a plant covering or fuel. That is, solid fuel formed from the partial decomposition of dead vegetation under conditions of high humidity and limited air access (initial stage of coalification). Included is only that portion of peat used as a fuel.

Source: Narodnoe Khozyaistvo SSSR, Soviet Government Publication Moscow, USSR various years.

especially gas production rising from 7.8% in 1960 to over 30% in 1986 and oil from 30% to 50% in the same period. The low quality sources such as peat are gradually being phased out.

The increased share of better quality fuels are supposed to have had a beneficial effect on accelerated growth of the entire economy, agricultural production inclusive, because it made possible mechanization process. The rapid increase of the share of oil and natural gas also has considerably weakened the efforts of the state to develop and streamline the output of coal and shales, which in turn, are also becoming more uneconomical to produce or further develop.

An important part of the energy complex of the USSR is extensive construction and commissioning of nuclear and hydropower stations. There are large hydropower resources in the Soviet Union with enormous availability of untapped potential sources in this vast expanse of land and water. The gigantic ventures of the hydroelectric and nuclear generative capabilities were curtailed by the advent of the great Chernobyl disaster of 1986. Much attention is being devoted in long-range planning to raising the effectiveness of fuel and energy use.

In the account of a Soviet Delegation to an international conference sponsored by UNITAR (United Nations Institute for Training and Research) in 1981, the following very accurate statement about the predicament of Soviet energy distribution were made:

> The main fuel and hydroenergy resources (about 90 percent of the total) are located in the eastern regions of the country, while the main fuel and energy consumers are concentrated in the European part of the USSR. This discordance in the distribution of energy resources and consumers creates a certain difficulty and calls for the creation of powerful systems of transportation of fuel and electric power from the eastern to the western regions of the country.[1]

Oil Resources

In recent times, progress is continuously being made in developing raw material base of the oil industry. Oil production has increased tremendously over the past two decades, which are set out in Figure 7, due to intensive prospecting in new regions of the country, especially western Siberia which has been determined to hold great reserves. The depths of the reserves in eastern Siberia and the European parts, still makes it questionable how to factor the availability of oil in these regions into the overall reserves of the USSR, but

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[1]Reports of the Soviet Delegation, Long-Term Energy Resources (Ontario, Canada, UNTIAR International Conference, 1981), p. 2040.

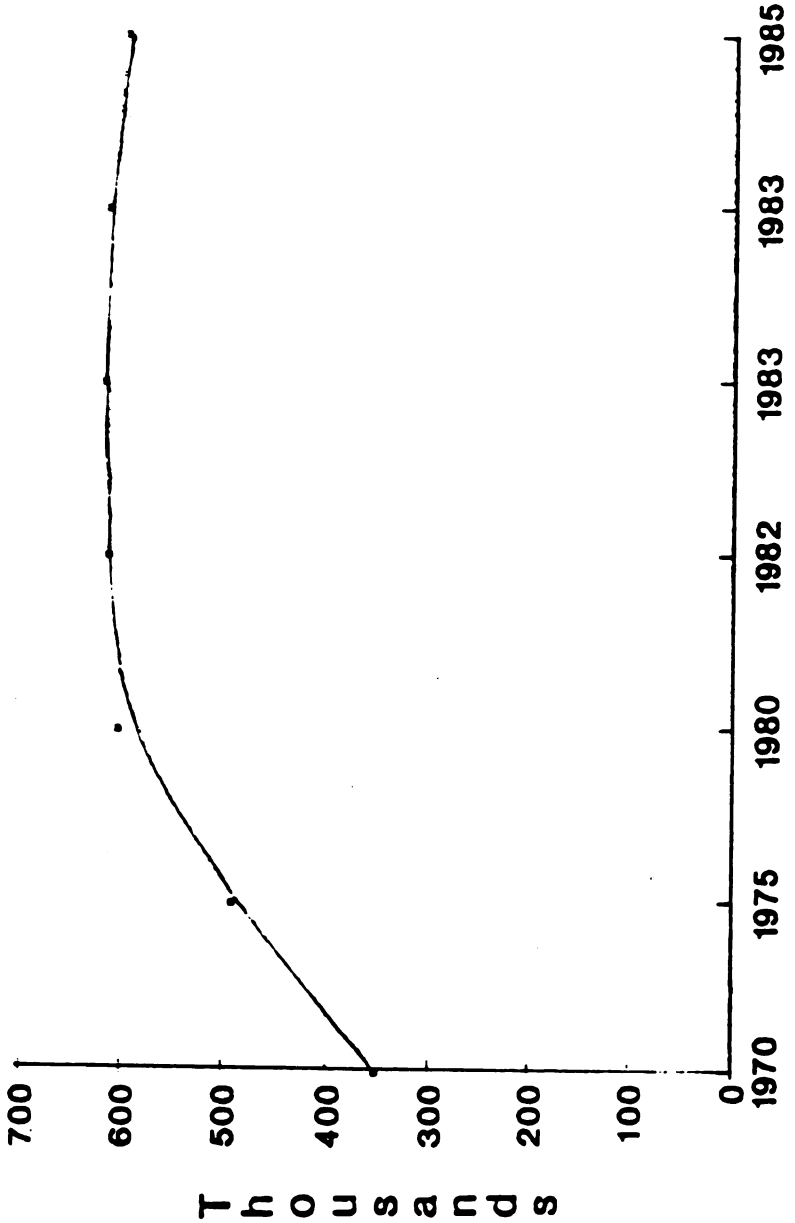

Figure 7. Crude Oil Production in USSR ('000 TOE).

Source: Table 21.

nonetheless, the future potentials for oil mining are enormous.

Natural Gas Resources

USSR resources of natural gas has been estimated in the hundreds of trillions of cubic meters; the greater part of which are located in Siberia and Central Asia. The main consumers are located in the European end of the country and the Urals, necessitating transportation of large quantities across enormous and treacherous terrains from east to west. There has been a rapid expansion in natural gas production since 1970 (Figure 8).

Soviet combustible shales being developed for natural gas production at present are rated among the best in the world. Combustible shales are found chiefly in the European part of the Soviet Union, and some deposits also in the Ukraine, Byelorussia, and other regions of the country.

Coal Reserves

At the end of 1978, coal reserves in the Soviet Union reached 276 billion tons, which included 182 billion tons of black coal and 94 billion tons of brown coal. The major base of the coal basis is the Kansk-Achinsk basin, with a balance of 140 billion in recent estimation of its reserves (1985). So far, 24 coal deposits have been explored in this basin, the largest of

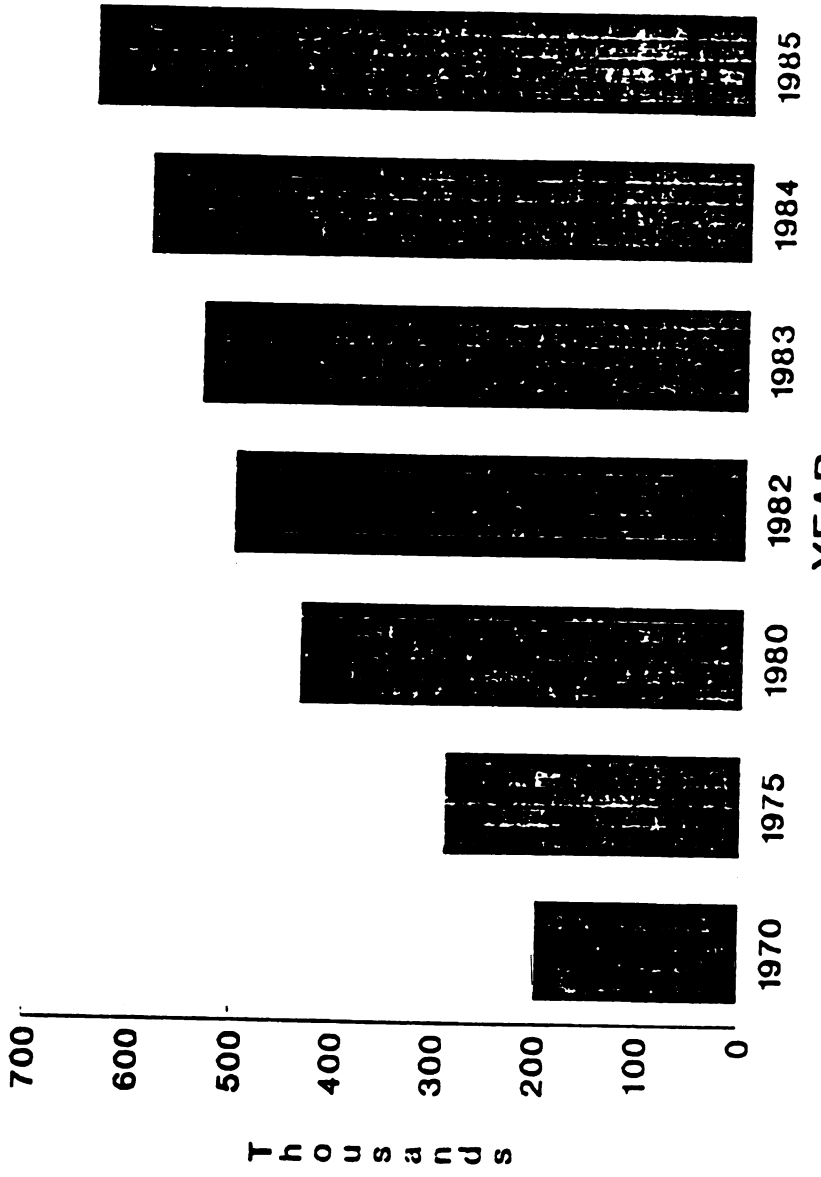

Figure 8. Expansion of Natural Gas Production in the USSR (mn m^3)

Source: Table 21.

Bordtin deposits.[1] Production figures for coal are set out in Figure 9. Currently the use of coal is declining and is being replaced by natural gas because of the increased emphasis on air quality and because natural gas is much easier and cheaper to produce and transport.

Hydropower Resources

The hydropower potential of the USSR is estimated at 3.9 trillion KWh average annual power generation. Of the reserves, 85% are concentrated in the rivers of Siberia, Central Asia, and the Far East. The hydropower potential that are economically profitable to develop at present is claimed to be in the range of 1-2 trillion KWh.[2] However, there is no definite account available of the process by which planners decide on the allocation of investment funds between energy and the remainder of the economy and allocation among the various energy carriers.

The USA

The USA is a country with abundant energy resources, but constantly haunted by the spectre of energy scarcity. It is, in most instances, assumed that

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[1]USSR, Agriculture and Trade Reports. Situation and Outlook Series, 1987-1989 (Washington, D.C.: Publication of the United States Department of Agriculture, Economic Research Service, 1981), p. 2040.

[2]Soviet Government Statistics (various years).

Figure 9. Trends of Coal Production in the USSR (1970-1986).

Source: Table 21.

the U.S. does not indeed have an overall energy policy that encompasses all spheres of energy production and use as exists in the USSR. Each piece of the energy policies of the United States was conceived in isolation, unrelated to any broad concept of natural need, and each piece was implemented independently of the conflicts and contradictions among the several pieces.

Oil Resources

The U.S. was once the paramount oil producer in the world, but it is currently ranked third after the USSR and Saudi Arabia. In most cases, it is generally believed that U.S. oil import levels are understated, and understated seriously.[1] The shale oil deposits of the American West contain well over 600 billion barrels of potentially recoverable oil, which are equivalent to some three times the known reserves of Saudi Arabia.[2] A massive program would be required to make a significant contribution from unconventional oil sources to the U.S. energy resources. However, in the U.S. these unconventional sources lie far beyond the planning horizon possible with today's political and economic

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[1]Robert Mabro, ed., World Energy Issues and Policies--Proceedings of the First Oxford Energy Seminar September 1979 (Worcester: Oxford University Press. 1980), pp. 228-229.

[2]Ibid., p. 230.

environment and could well be the reason for the vast discounting of these enormous energy resources.

Natural Gas

Natural gas is a very important part of U.S. energy supply. Under the U.S. system of natural gas pricing, each source of gas if flagged and assigned a particular price, which remains fixed, irrespective of what happens subsequently in the market. Gradually, these regulations are being removed. At the present time, the gas discovery rate in the U.S. is less than half of the production rate,[1] so today's production is not self-sustaining; rather, it is production out of a dwindling inventory of proven reserves. There has been no real success in making additions to proven reserves since the late 1970s, in spite of the dramatic rise in activities, and the reserve-to-production ratio is still falling.[2] It has been determined that there is a tremendously large potential gas resource in the U.S. This resource occurs in unconventional deposits, among the most widely publicized of which are the gas pressured

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[1]Ibid., p. 231.

[2]Oil and Gas Journal, International Petroleum News and Technology. A Pennwell Publication, March 26, 1990, p. 33.

brine deposits of the Texas Gulf costs with possibly 1,000-trillion cubic feet of gas in such deposits, at depths which are within the compass of conventional production technology.[1]

Coal

The U.S. is amply endowed with coal resources. Known deposits exceed 1,000-billion tons which have been reasonably precisely delineated in numerous publications. That is equivalent to 1,500 years of consumption at current U.S. levels. The route to coal-based plenty is beset with obstacles, the most widely-publicized of which is the environmental hazards associated with the direct combustion of coal. The problem with coal in the U.S. is not production, but in sharp contrast with oil and gas, utilization is the bottleneck critically dominating coal as an energy source. Currently, the U.S. has surplus coal-producing capacity, in spite of an overall energy shortage, but there are no satisfactory capability to consume it.

For an economy, such as that of the U.S., the expansion of coal use will lead to a creation of a

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[1]Robert Mabro, ed., World Energy Issues and Policies--Proceedings of the First Oxford Energy Seminar September 1979 (Worcester: Oxford University Press. 1980), p. 230.

synthetic fuels program. The key question is how the U.S. can use an old-fashioned fuel like coal and turn it into the forms of fuel which a modern industrial society is structured to use, namely gas or liquids.

Nuclear

The U.S. has very large deposits of low- and medium-cost uranium, large enough that they could serve even the earlier, larger-scale nuclear program for a period of at least 30 years.[1] At the present time, U.S. policy toward nuclear power to say the least, is not a high priority. The administration has chosen not to promote nuclear power actively as a transition to some more remote policy based on renewables, such as solar or wind power. The momentum of the U.S. nuclear program has been lost. Construction is slowing down; some plans have been cancelled, and other have been deferred.

Less nuclear power translates into more gas consumption, and hence, more oil imports via substitution.

Comparing the USA and the USSR

Soviet political and economic journalists show a regrettable prediction for illustrating comparative rates

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[1]Robert Mabro, ed., World Energy Issues and Policies--Proceedings of the First Oxford Energy Seminar September 1979 (Worcester: Oxford University Press. 1980), p. 230.

of growth in branches of Soviet and American industry by the use of graphs based on percentage increases.[1]

A more balanced and alternative view of the progress made by both countries in natural gas production in the 1970's and first half of the 1980's is given by the comparative production figures in Tables 21 and 23, and set out in Figure 10.

The USSR, until the early 1980's, was second only to the United States in the production of natural gas. The yearly production during these periods was greater in the United States than in the USSR, but during the 1980's until present, the set out indications in Figure 10, shows that the average quantitative increase each year has been higher in the USSR relative to the USA.

This would imply that the disparity between the two powers is drastically changed in opposite directions with the USSR producing more natural gas than the USA. The USSR is in a much stronger position with regard to the ratio of consumption to reserves. In 1982, the United States had sufficient proven reserves for only ten

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[3]Ian F. Elliot, The Soviet Energy Balance: Natural Gas, Other Fossil Fuels, and Alternative Power (New York: Praeger, 1974), p. 37.

Table 23. USA Energy Production Figures 1970-1986.

	1970	1975	1980	1982	1983	1984	1985	1986	Growth % (p.a.) 1970-1980	1970-1975	1975-1980	1980-1985
Total Energy (/000 TOE)	2,103,701	1,963,016	2,105,207	2,004,373	1,908,824	2,054,071	n.a.	n.a.	0.0	-1.4	1.4	-0.6
Coal	550,388	575,901	710,384	712,777	656,568	750,262	741,309	736,462	2.6	0.9	4.3	0.9
Lignite	5,409	17,979	42,307	47,942	52,933	57,262	62,541	n.a.	22.8	27.1	18.7	8.1
Crude Oil	475,289	413,090	424,196	425,591	427,515	438,127	438,950	439,774	-1.1	-2.8	0.5	0.7
Petroleum Products	568,870	645,937	693,411	632,400	618,121	646,282	n.a.	668,755	2.0	2.6	1.4	-1.7
Natural gas (mn m^3)	595,057	545,300	549,463	502,883	453,978	492,489	465,272	504,741	-0.8	-1.7	0.2	-3.3
Manufactured Gas (mn m^3)	28,353	25,400	21,000	12,120	10,520	12,700	n.a.	n.a. 3.6	-3.0	-2.2	-3.7	-11.8
Uranium (U content in tons)	9.9	8.9	16.8	10.3	8.1	5.7	4.3	2,578,221	5.4	-2.1	13.5	-23.5
Electricity (mn KWh)	1,639,771	2,003,002	2,354,384	2,303,287	2,367,637	2,472,302	2,469,072	19.9	3.7	4.1	3.3	1.0
Of which hydro (mn KWh)	250,699	303,153	277,721	310,739	333,564	322,550	n.a.	n.a.	1.0	3.9	-1.7	3.8
Nuclear (mn KWh)	21,797	172,506	251,115	282,773	293,677	327,634	n.a.		27.7	51.2	7.8	6.9

SOURCE: The World in Figures (The Economist); 1986 Energy Statistics Yearbook (UN Resources).

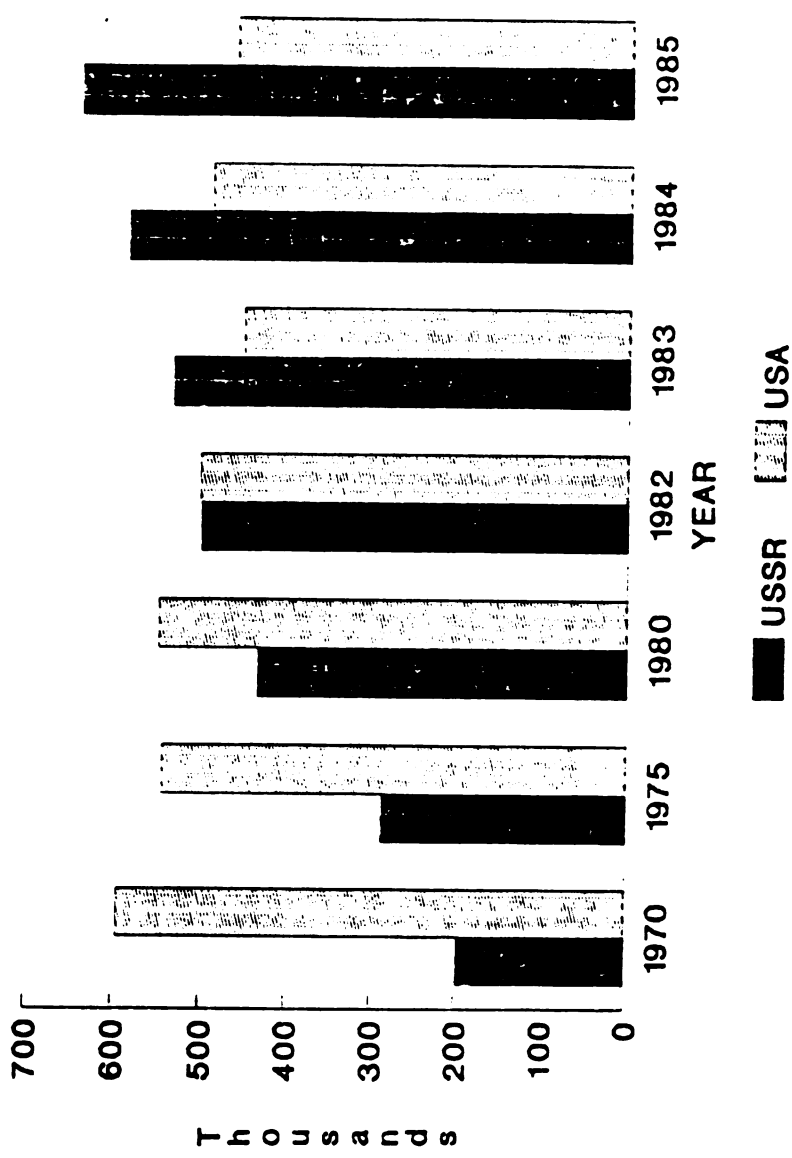

Figure 10. Comparison of Natural Gas Production in the USSR and USA (mn m^3)

Source: Tables 21 and 23.

years, while the USSR could continue to extract gas at the 1982 level for about fifty years.[1]

Also, the Soviet Union is in a stronger position than the United States as regards domestic oil reserves. Up until 1971, the total world production of crude oil was 2,465 million metric tons. The major oil-producing nation was the United States, and the USSR came second. Over recent years, however, the rate of extraction in the USSR has been rising steadily at about 6-7% compared with the world average increase of about 2-3% with a net drop in production in the United States in the early 1970's. Even allowing for factors such as conservation during the world glut of oil, output of oil in the Unites States is unlikely to expand at the same speed as in the USSR, which was certainly the major producer in the 1980's.

Production per capita in the United States is expected to remain high, in view of its smaller population. It is also worth noting that while the USSR exports large quantities of its crude oil, the United States refines and consumes far more than it produces. Overall, the general trend in the production of energy in the United States tends to have flattened out or on the

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[1]Ibid., p. 38.

decrease when one considers its total energy production, relative to an almost steady growth in the production of energy in the Soviet Union. This trend is likely to continue into the far future in a general framework of total energy production, if for nothing else, but the sheer size of the USSR land mass and the reserves of resources at their disposal, coupled with population size relative to the USA.

Research and Development

Despite considerable input of resources into the Research and Development (R&D),[1] sector by the more than 5,000 scientific institutions and 1.5 million researchers in the Soviet Union (1987) indicated in Table 24, the output was disappointing. The goal of catching up scientifically with the United States, in the 1960's, has now been replaced by a struggle not to lag further behind.

Primarily, the Soviet bureaucracy which fostered poor decision making, perverse personnel policies,

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[1]At this level of generality, Soviet discussions of energy and agricultural policy and the associated Agro-Energy R&D policy seem eminently sensible. The planners are fully appreciative of the problem of uncertainty, the need for revisions of forecasts, the importance of creating a backlog of information that can improve decisions as time passes.

Table 24. Number of Research Workers in the USSR (end-of-year-figures; thousand of people)

Year	Total Number of Research Workers (Including Educators of Institutions of Higher Learning)	Of Whom Holding Degree of		Of All Research Workers Those Holding Academic Rank of			
		Doctor of Science	Candidate of Science	Academician, Associate Member of the Academy, Prof.		Senior Research Worker	Junior Research Worker and Assistant
1950	162.5	8.3	45.5	8.9	21.8	11.4	19.6
1960	364.2	10.9	98.3	9.9	36.2	20.3	26.7
1970	927.7	23.6	224.5	18.1	68.6	39.0	48.8
1980	1373.3	37.7	396.2	27.4	110.7	66.0	41.1
1985	1491.3	44.3	463.5	31.0	131.8	77.5	39.7
1986	1500.5	45.7	472.8	31.8	134.1	78.0	38.4
1987	1515.3	47.1	483.4	32.6	136.7	79.8	36.2

SOURCE: USSR Government Statistics.

disastrous information policies and a misguided system for financing scientific research, bore responsibility for the low efficiency of Soviet science.

The party and bureaucracy interfered in and greatly retarded progress of scientific work. As a result of personnel policies riddled with party favoritism, incompetent people were often appointed and promoted to positions with the results too frequently being poor and misguided decisions. People with favorable KGB files were more apt to being given responsibilities than those with keen scientific abilities.[1] This no doubt resulted in a degradation of the standards of professional thoroughness. In order to progress through the hierarchy of scientific bodies, it became impelling to practice obedience to the party. This facilitated access to power, money, and privileges.

A society restricted by the Soviet form of government had little or no access to necessary information. The scientific community suffered from this deprivation of information that could have been used to advance Soviet Science. Special permission was often required to consult foreign scientific journals, when

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[1]Michael Ellman, The USSR in the 1990s--Struggling Out of Stagnation Special Report No. 1152 (London: The Economist Intelligence Unit, 1989, pp. 33-39.

available. It was even much more difficult to attend international conferences or have foreign study leave.

Allocation of funding for research is done through the Academy of Sciences and other government bodies. Bodies which have been implicated in favoritism and consequent incompetence. People with inadequate knowledge and judgment of science are in positions to evaluate, select, and fund scientific projects. Invariably potentially beneficial projects are insufficiently funded or rejected while more absurd projects get adequate funding. In view of these seeming fundamental problems of decision making, personnel, information and finance, it is scarcely surprisingly that there is an enormous "performance gap" between the huge Soviet inputs into scientific research and the meagre results. Professor Frank-Kamenetski, head of a laboratory of the institute of Molecular Genetic of the USSR Academy of Sciences believes[1] that a system patterned after the U.S. or West Germany, in which individual project leaders make grant applications which are judged on merit, would aid USSR scientific development.

Perestroika has initiated efforts to remove the discrepancies between input into, and results from Soviet

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[1]Literaturnaya Gazeta, 1988.

sciences. Progress in this direction has been slow and the directions have been misused in cases. Personnel evaluation, for instance, has resulted in the removal of independent scientists rather than the gifted being promoted and the incompetent weeded out. Unless such injustice is removed and corrective measures properly applied, the Soviet Union will continue to lag behind the U.S. and the other Western countries scientifically.

The need for innovation in the USSR is poorly placed. It is often in order to overcome supply difficulties and hardly to expand the market. The industry is reactionary simply because the economy is saddled with shortages of input and process limitations. Market limitations or product innovations are not the problem. It is evident though that the financial incentives for innovation are poor because of the long time it takes inventions and processes to reach the market. Martens and Young[1] found that it took the USSR three times as much investment time as the U.S. or West Germany to implement 50% of their inventions. The transition to oxygen converter process for steel has lagged far behind in the USSR even though the introduction was at a similar time as in the US, West

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[1]Martens and Young, Soviet Economy in a Time of Change (Washington, D.C., 1979), pp. 505-506.

Germany, and Japan.[1] This apparent lukewarm attitude toward change and innovation is primarily a result of state interferences, policies, and attitudes.

The Soviet system of investment encourages long construction periods. The result is that by the time Soviet industrial plants are completed, rapid technological progress in the West makes them obsolete for the period they are completed. Nonetheless, firms in the USSR have little incentive to develop new products because of a centrally planned economy that lacks competition and has a guaranteed market.

Soviet economic growth has been supported by the duplication of new ideas and projects from abroad because of the slow developments of domestic inventions.

Technology transfer in the civilian sector has not succeeded in advancing the technical level of the USSR since the technology or parts are usually not reproduced before they become outdated. The military sector has fared better because of the emphasis placed on military competitiveness in the past.

Obsolete equipment contributes to the low quality of Soviet consumer goods. Equipment in rarely modernized or factories re-equipped over a period spanning 15-20

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[1]Michael Ellman, The USSR in the 1990s--Struggling Out of Stagnation, Special Report No. 1152 (London: The Economist Intelligence Unit, 1989), p. 24.

according to A. P. Biryukova[1] who observed that over 1971-85, light industry which accounted for 14% of total industrial output only received 4% of total industrial investment.

The government has set out to increase investment in light industry such that by the late 1990's, investments would mature. At this time, it is hoped that the quality and quantity of light industry output and consumer durables should increase. Gorbachev has taken steps in the hope of productively restructuring the infrastructure. Quality control and investments have been introduced in order to raise short-term and long-term project quality, respectively. The state monopoly on trade is being removed and joint ventures with Western firms allowed, especially in the energy sector, such as the joint venture of the natural gas production with France and some other industrialized western countries. This helps to accelerate technical progress.

It has been found necessary, however, to continue with a large-scale centralized Research and Development program in the areas of new materials, computer technology, and biotechnology. It seems inevitable that the success of these reforms are dependent upon the success of the radical economic reform in the USSR. The

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[1]Pravda, 4 March 1988.

author does not foresee significant results before the mid-1990's.

Summary--Research Question 2

The goals of the Soviet agricultural policy are to maximize domestic agricultural output, to maintain stability in production growth, and to increase efficiency of resource use in agriculture, while remaining consistent with communist ideology. Thus the Soviet Union still tolerates devoting almost 35% of the state expenditures and retains a large agricultural labor force still insufficient to meet agriculture's needs[1] and also unavailable for use by other labor-short sectors of the economy.

The specific empirical question examined is whether, from the point of view of a comparative analysis, there has been a widening of inter-country disparities over recent years and various planning periods and process as pertain to the economies of the

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[1]Migration from farms involves primarily the young and the more skilled, leaving behind people largely outside of working age. Available demographic data suggest the migration is on an increase now. The loss of trained personnel is having a great deal of strain on Soviet agricultural production. Official statistics suggest that fewer than half of the Soviet graduates from agricultural institutions return to work on the land.

USA and USSR, mostly in the agriculture and energy sectors, as posed by Research Question 2.

It is conclusive by evidences shown that over the span of various planning periods, especially in the emphasized recent decades, from the 1960's to 1980's, there occurred numerous changes in the performances of both sectors (agriculture and energy) in the economies of the USA and USSR and a great widening of these differences in the agriculture and energy sectors of both economies. The Soviet grain production situation has grown worse, becoming a source of "leakage" in the entire economy. Progress has been made and more energy resources brought into use in very large quantities surpassing the lead that the USA had in this sector in the past. Nonetheless, varied indicators show that the USSR is still far from maximizing its potentials in improving agriculture and energy productivity, to surpass or be at par with the U.S.A.

There is a great reliance on oil and gas almost exclusively as the means to satisfy the growing energy demand in the Soviet Union.

Summing up general results of the state of explored fuel and energy resources, one can say that there has been a great leap in the use of these resources, especially natural gas, in the USSR relative to the USA.

Nonetheless, Soviet sciences is marred by big inputs and meagre outputs. This discrepancy is caused by poor decision-making processes, perverse personnel policies, disastrous information policies and an ineffective system for financing scientific research,[1] and this, though not in itself conclusive, is a major contribution to the reason why they lag behind the USA and many industrial countries in the West and a cause of the widening of the "performance gap."

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[1]Michael Ellman, The USSR in the 1990's--Struggling Out of Stagnation, Special Report No. 1152, 1989 (London: The Economist Intelligence Unit), pp. 36-38.

CHAPTER IV

ENERGY UTILIZATION IN AGRICULTURE

Energy is an important input in the agricultural production process of both the USA and the USSR. Many decisions affecting the current structure of agriculture and use of energy in agriculture were made during an era of inexpensive energy.[1] Prices for oil, natural gas, and liquid petroleum gas (LPG) have risen substantially over the past ten to fifteen years.

Since 1972 the world economy has faced two severe shocks: food production and petroleum. Both commodities are basic to the economic well being of all countries, hence shortages and rapid price increases for both energy and food have had serious impacts on the world economy.

Fossil fuel is one of the major inputs in agricultural production. Currently the high yields with relatively small inputs of manpower are associated with

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[1]Anthony F. Turhollow Jr. et al. Potential Impacts of Future Energy Price Increases on U.S. Agricultural Production. Ames, IA: Center for Agricultural and Rural Development (CARD Report #116), Iowa State University, April 1983, p. 1.

mechanized agriculture and are due essentially to ample supplies of inexpensive fossil energy.

In agriculture production, fossil energy has a twofold use, that is to increase crop, livestock, and forestry yields and also to replace labor.[1] The major inputs that increase crop yields include energy used in fertilizers, pesticides, herbicides and irrigation. The major inputs for livestock production are forage and grains used for feed. Though energy used to reduce human labor input in crop production has less effect on crop yield, it nonetheless, helps to facilitate the timing and operations of most farm processes.[2] Hence, machinery has greatly reduced the labor input into agricultural production.

There has been a significant increase in yield in agricultural production in the U.S.A. and USSR since the 1940s and 1950s. This has been as a direct result of improved livestock breeding and development of high yielding crop varieties, coupled with improved and organized farm management. There has been increased use of fertilizers, pesticides, irrigation, and rising use of

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[1]David Pimentel, Ed., Handbook of Energy Utilization in Agriculture (Florida: CRC Press, Inc., 1980), p. 3.

[2]Ibid., p. 4.

farm machinery, all of which depend primarily on fossil energy to operate.

There is no precise way to account for the energy used indirectly in agricultural production. This would be the energy that goes into the production of machinery, equipment, buildings, and other nonland resources that contribute to food and fiber production over the long term and are normally treated as capital assets, one of the most important of which is farm machinery.

The USA

Since the turn of the century, energy use in U.S. agriculture has changed dramatically, although the amount of harvested land has remained relatively constant. Since 1920 with a possible slightly downward trend in the rate of increase, the average index of farm output in the U.S. has increased two and a half times between the 1915 to 1920 period and the decade of 1977-1986. (See Table 6). Most of this increase is accounted for by energy-intensive technology. Research suggests that about half of the increase in energy inputs has gone to improve productivity (with such inputs as fertilizer and chemicals).

Complete data on energy consumption in agriculture are not available for recent years. The

available data base in most research reports date back to 1974 during the period of the energy crisis with a revision in 1981. However, one important study published in 1984 as an update to the available 1974 data base estimated that approximately 3% of all the energy consumed in the United States is used on farms. Gasoline, diesel fuel, heating oil, and liquefied propane (LP) gas constitute nearly half the energy used in agriculture in 1981.[1]

Stanhill also indicated that the entire U.S. food system, including all operations from field production to the kitchen table, uses about 16.5% of the nation's energy: 2.9% in production agriculture, 4.8% in processing, 1.7% in distribution and transportation, and 7.1% in food preparation and rural living.

Production agriculture in the United States used approximately 28.8 billion liters (7.6×10^9 gal) of liquid fuel in 1980.[2] Most of this is used in mobile and stationary combustion engines. Indirect energy use in

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[1]G. Stanhill, Energy and Agriculture (New York: Springer-Verlag-Berlin Heidelberg, 1984), p. 169.

[2]Randall E. Torgenson and Gene Ingalsbe, "The Future of Farmer Cooperatives" (East Lansing, MI: Cooperative Extension Service, Michigan State University, 1984).

the form of agricultural chemicals (fertilizer and pesticides) increased about 11%.[1]

Energy Use by Fuel

In clarifying energy use by the type of fuel, there are wide variations in which the four types of fuel are used for agricultural purposes.

Diesel used for machinery constitutes about 80 percent of total machinery energy use and between 44 and 53 percent of total energy. Most of the diesel not used for machinery is used for the interregional transportation of crops.[2]

The bulk of natural gas required by agriculture is used in the production of nitrogen fertilizers. The amount of energy used in nitrogen fertilizer production is fixed in proportion to the amount of nitrogen fertilizer used. So, changes in total natural gas use closely follow changes in nitrogen fertilizer use.[3]

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[1]G. Stanhill, Energy and Agriculture (New York: Springer-Verlag-Berlin Heidelberg, 1984), p. 169.

[2]Anthony F. Turhollow Jr., et al., Potential Impacts of Future Energy Prices Increases on U.S. Agricultural Production (Ames, IA: Center for Agricultural and Rural Development, Card Report #116), Iowa State University, April 1983), p. 37.

[3]Ibid., pp. 37-38.

LPG is used either for irrigation purposes or for crop drying which accounts for more than 85 percent of total LPG use.[1]

The use of electricity in irrigation makes up a significant portion of total electricity use. Irrigation does not account for a significant portion of total fuel use for the other three fuels.[2] Electricity is quite inexpensive in the Northwest, and due to the predominance of surface water irrigation in the Northwest and Southwest, the energy required to obtain and apply an acre-foot of water is generally less than in other important irrigation areas in the Great Plains and the South Central states.[3]

Crop Production--Irrigation

Production alternatives within the producing areas are represented by more than 15,000 rotations which allow for producing crops in various combinations with varying tillage practices and varying levels of fertilizer and irrigation water utilization.[4]

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[1]Ibid., p. 38.

[2]Ibid., p. 39.

[3]Ibid., p. 42.

[4]Ibid., p. 11.

Much energy is needed to get water onto irrigated cropland and such needs are very demanding on existing energy sources. The importance of crop production in the U.S. through irrigated fields focuses attention on energy quantities, prices, and expenditures.

Irrigated crop acres in the U.S. have increased from 7.5 million in 1900 to 48 million in 1988.[1] These acres account for 15 percent of harvested cropland (Table 25).

Any effort to intelligently discuss irrigation with regard to the U.S. cropland will be futile without putting it in a regional perspective. Much of the cropland in the Western section of the country would not be of any agricultural significance without irrigation. For example, California, a leading state in the value of farm products sold, cultivates almost 98% of such produce on irrigated farms.[2] The arid Southwest has lost irrigated cropland in states experiencing declining

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[1]John Hostetler & Gordon Sloggett, "Energy and Irrigation," in Inputs Outlook and Situation ISO-3 (Washington, D.C.: U.S. Department of Agriculture, Econ. Res. Serv., August 1984), p. 23 and "Agricultural Resources--Cropland, Water, and Conservation," in Situation and Outlook Report AR12 (Washington, D.C.: U.S. Department of Agriculture, Econ. Res. Serv., September 1988), p. 27.

[2]U.S., Department of Commerce, Bureau of Census, Census of Agriculture, volumes of various year. Washington, D.C.: U.S. Government Printing Office.

Table 25. U.S. Irrigation Trends from 1900-1988.

Year	Harvested Acreage (Million Acres)	Irrigated Acreage (Million Acres)	Percent Share Irrigated
1900	415	7.5	2
1930	359	19.5	5
1950	344	27.9	8
1978	320	50.3	16
1982	326	49.0	15
1983	380.5	44.3	12
1984	373.5	45.5	12
1985	367.2	47.2	13
1986	356.8	46.9	13
1987	331	45.7	14
1988	328.2	47.9	15

Source: USDA Agricultural Statistics, Various Issues and "Agricultural Resources--Cropland, Water, and Conservation," in Situation and Outlook Report AR12 (Washington, D.C.: U.S. Department of Agriculture, Econ. Res. Serv., September 1988), p. 27.

groundwater levels.[1] In parts of the humid Eastern states, supplemental irrigation has been increasing as farmers attempt to raise returns per acre and reduce weather risks. Supplemental irrigation has increased in the Lake states, most of the Corn Belt, and especially the Southeast.

Pump irrigated acreage in the United States increased over 27% from 1974 to 1983 with groundwater being the major source (Table 26). Electricity, diesel,

Table 26. Irrigated Acreage with On-Farm pumped water (in millions Acres) 1974-1983.

Water Source	1974	1988	1980	1983	Acreage Change 1974-83	Change 1974-83
Ground Water	25.6	30.0	31.6	33.1	7.5	29.0
Surface Water	7.3	8.0	7.9	8.2	.9	12.0
Both Sources	2.2	2.3	3.1	3.3	1.1	50.0
Total	35.1	40.3	42.6	44.6	9.5	27.0

Source: Agricultural Statistics (USDA), Vols. 1974-1983.

gasoline, natural gas, and liquefied petroleum gas (LP gas) are used for pumping irrigation water. Electricity is the energy source most widely used. The Mountain and Pacific regions accounted for more than half of all acreage irrigated with electricity in 1983 (Appendix Table B-1). Annual rates of electricity use for irrigation pumping increased 5% between 1974 and 1980. Between 1974 and 1980, rates of growth in electricity use were highest in the Corn Belt and Delta States, but dropped in Appalachia, where North Carolina accounted for most of the change (Appendix Table B-1).

Natural gas is also widely used; in 1983, about 11 million acres were irrigated using natural gas-powered pumps, mainly in the petroleum-producing Plains and Mountain regions. There was an increase in annual growth rate in natural gas use in the Northern Plains from 1974 to 1980, and a decrease in the Southern Plains use during the same period, which may have been due primarily to the overall decline in irrigated acres and the increase in natural gas prices.

There has been an increase in the acreage irrigated under diesel fuel pumping from 3.9 million in 1974 to almost 8.6 million in 1983. The use of such fuels are mainly concentrated in the Northern Plains, Southeast, and Delta States, where electricity and

natural gas prices are higher and installation costs for these energy sources are substantial.

The use of liquid petroleum and gasoline are on the decline. These two energy sources are used in localized situations where smaller, more mobile irrigation systems are used, and other, cheaper alternative fuels are unavailable.

According to Hostetler and Sloggett, energy use per acre for on-farm irrigation pumping depends on three factors:[1]

1. distance the water must be lifted from its source to the field
2. the type of application system used, and
3. the quantity of water applied.

The desert areas of Arizona, California, and Nevada and the dry plains of the Pacific Northwest require more water per acre, and hence, greater amounts of energy for irrigation than does acreage in the more humid East. This is also influenced by the kind of crops grown in these regions.

Per acre energy use for almost all types of fuel rose between 1974 and 1983 as shown in Table 27. Use of electricity increased by 4%; diesel, gasoline, and LP gas

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[1]John Hostetler and Gordon Sloggett, "Energy and Irrigation," in Inputs Outlook and Situation ISO-5 (Washington, D.C.: U.S. Department of Agriculture, Econ. Res. Serv., August 1984.

Table 27. Total and Per-Acre Energy Use for On-Farm Pumped Irrigation Water (1974-1983).

Fuel Type	Unit	1974	1977	1980	1983	Annual Average Change (%)	
						1974-80	1980-83
Total Use:							
Electricity	Mil Kwh	16	19	21	23	5.0	3.0
Diesel	Mil Gal	184	360	429	530	22.0	8.0
Gasoline	Mil Gal	67	72	61	57	-2.0	-2.0
Natural Gas	Mil MCF	129	143	145	144	2.0	-0.5
LP Gas	Gal	239	234	254	257	1.0	0.4
Per-Acre Use							
Electricity	Kwh	1,013	1,044	1,029	1,055	0.3	0.8
Diesel	Gal	47	53	56	62	3.0	4.0
Gasoline	Gal	45	60	61	63	6.0	1.0
Natural Gas	MCF	12	13	13	13	1.0	0.0
LP Gas	Gal	72	98	98	99	6.0	0.3

Source: Agricultural Statistics (USDA) for various years.

use per acre increased by more than 30% from 1974 to 1983, but the use of natural gas remained fairly constant.

The increase in use of energy per acre were attributed to three main reasons:

--79% of the increase in irrigated area relied on groundwater rather than surface water supplies, i.e., 7.5 million of the 9.5 million-acre increase was in groundwater irrigation

--Groundwater levels are declining in some areas of the Plains and Mountain regions, making the lifts greater

--Of the newly irrigated land, sprinkler systems were utilized on 86 percent of the acreage, rather than gravity-flow systems. A significant share of these systems relied on diesel fuel for pumping.[1]

Total energy use for on-farm pumped irrigation increased for all fuel sources except gasoline (Table 27). The largest increase was diesel that almost tripled in use between 1974-1983. Electricity use expanded by almost 5 percent per year, primarily due to groundwater pumping.

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[1]Maurice Levy, and John L. Robinson, Eds. Energy and Agriculture: Their Interacting Futures--Policy Implications of Global Models (1984), p. 130.

Table 28. Changes in Farm Energy Prices--USA--1974-1983

	$ Per Unit				Average Annual Changes (%)	
	1974	1977	1980	1983	74-80	80-83
Electricity (kwh)	0.027	0.035	0.055	0.065	17	7
Diesel (gal)	0.37	0.45	1.00	0.99	28	-0.3
Gasoline (gal)	0.47	0.57	1.15	1.18	24	1
Natural gas (MCF)	1.00	1.50	2.50	4.00	25	20
LP Gas (gal)	0.30	0.39	0.62	0.77	18	8

Source: U.S. Department of Commerce, Census of Agriculture. Vols. for various years (Washington, D.C.: U.S. Government Printing Office.

There has been a tremendous change in energy prices (Table 28) and, consequently, the cost of irrigation. Electricity expenditures accounted for about 46% of all energy costs incurred for irrigation in 1983. Natural gas has been the cheapest fuel for internal-combustion engines, and it is used extensively for pumping irrigation water in the Great Plains and Mountain regions. Irrigators close to natural gas distribution systems in these areas enjoy a cost advantage over users of diesel, gasoline, LP gas, and electricity. However, recent increases in energy prices are changing the price relationships. From 1974 to 1980, electricity and LP gas prices rose annually by 17 percent and 18%, while gasoline, natural gas, and diesel increased 25 percent or more. Significantly, between 1980 and 1983 diesel prices actually declined while all other energy sources, except natural gas, increased 3 to 8% annually. Natural gas prices rose by 20% a year.

Pumped irrigation energy expenditures in the major producing regions of the Lake States, Southeast, and Corn Belt grew much faster than in other regions from 1974 to 1983, but in the Delta States prices rose faster between 1989 and 1983 than during 1980-84 (Appendix, Table B.2).

Fertilizer Production and Usage

Fertilizer, which requires enormous energy for its production, is the largest energy input in producing field crops. On the average, about 35 percent of the energy used in growing crops is required to produce fertilizer.[1] Thus, efforts to use fertilizer more efficiently by soil testing will save both energy and money. Research has shown that as much as $43 per acre and 1,800 BTU's per bushel annually can be saved by applying the correct amount of fertilizer to grain production.[2] Fertilizer production technology that is typical of current U.S. practice was used as basis for estimating energy required for processing and eventual production of fertilizers used in the agriculture production processes. Papers by Blouin and Davis[3] give detailed breakdowns of the energy required for fertilizer production operations which can be summarized as follows.

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[1]G. M. Blouin, and C. H. Davis, "Energy Requirements for the Production and Distribution of Chemical Fertilizers in the United States." Paper presented at Southern Regional Education Board Meeting, Atlanta, Georgia, October 1975), p. 320.

[2]Marvin Duncan, and Kerry Webb, Energy and American Agriculture (Federal Reserve Bank of Kansas City, Research Division, 1980), p. 29.

[3]G. M. Blouin and C. H. Davis, "Energy Requirements for the Production and Distribution of Chemical Fertilizers in the United States," (Paper presented at Southern Regional Education Board Meeting, Atlanta, Georgia, October 1975), p. 321.

Nitrogen fertilizers. Nitrogen fertilizers have embodied in them a substantial portion of all energy used in agriculture, between 25 and 30 percent in all solutions. Nitrogen fertilizer can serve as a substitute input for land and irrigation water. As the level of demand increases, so does the intensity with which nitrogen fertilizer is used.[1]

Essentially, all nitrogen fertilizer is derived from ammonia. A substantial proportion of the ammonia (37%) is directly applied, and almost all of the remaining is used to produce urea, ammonium nitrate, or compound fertilizers. An approximation of the total nitrogen requirement for each is given in Table 29.

Ammonia. About 95% of the U.S. ammonia production is based on natural gas with about 38,000 standard cu. ft. of gas (at 900 BTU/cu. ft.) required per ton of ammonia. Total energy consumption is about 42 million BTU/ton N. About 99% of the energy is supplied by gas and the remainder by electricity.

Ammonium nitrate. Oxidation of ammonia to nitric acid and then neutralization of the nitric acid with

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[1]Anthony F. Turhollow Jr. et al., Potential Impacts of Future Energy Price Increases on U.S. Agricultural Production (Ames, IA: Center for Agricultural and Rural Development, Card Report #116, Iowa State University, April 1983), p. 29.

Table 29. Production of Nitrogen Fertilizer, by Type

Type	Amount (Tons N x 10^6)	Percent of Total
Anhydrous Ammonia	3.4	37
Ammonium nitrate	2.0	22
Urea	1.4	15
Ammonium sulfate	0.2	2
Mixtures	2.1.	24
TOTAL	9.1	100

Source: G. M. Blouin, and C. H. Davis, "Energy Requirements for the Production and Distribution of Chemical Fertilizers in the United States" (Paper presented at Southern Regional Education Board Meeting, Atlanta, Georgia, October 1975), p. 321.

additional ammonia produces ammonium nitrate fertilizer. Production of ammonium nitrate pills requires about 8 million BTU/ton N in addition to the energy required to produce the ammonia (total of 50 million BTU/ton N). For the ammonium nitrate solution, about 4 million BTU are consumed, not including ammonia preparation (total of 46 million BTU/ton N).

Urea. Urea is produced by reacting ammonia and carbon dioxide at high temperature and pressure. Conversion of ammonia to pilled urea requires about 7 million BTU/ton N, resulting in a total energy consumption of about 49 million BTU/ton N. About 3 million BTU/ton N are required to covert ammonia to urea solution, giving a total of about 45 million BTU/ton N. It is estimated that the 5.2 million tons of P_2O_5 consumed in 1974 consisted of about 3.2 million tons as ammonium phosphate and about 1.7 million tons as triple superphosphate, plus other mixtures used in the composition.

Potassium fertilizers. About 90% of the potash fertilizer consumed in the United States is derived from potassium chloride. About 40% of the potash is directly applied and about 60% is used in mixtures. About 4 million BTU is required per ton of K_2O for mining and processing of fertilizer grade potassium chloride.

Total energy consumption for the production of fertilizers. The total energy required for production of fertilizer in the U.S. is summarized in Table 30. The figures presented are the most recent available for actual measurements made in a comprehensive investigation of energy use in agricultural production undertaken by the Economic Research Services of the USDA in cooperation with the Federal Energy Administration, results of which were published as the 1974 Agricultural Energy Data Base (FEA/USDA, 1976). It is the author's opinion that improvements and technological progresses through better and greater machine efficiency, production management, and numerous conservative practices that have emerged in recent times, could have greatly altered the structure of the presented figures, but there is no available research or data to support such opinions. The total requirement is about 40×10^{12} BTU. Nitrogen materials and intermediates consume about 85% of the total energy required for production of U.S. chemical fertilizers.

Energy requirements for transportation and distribution. Blouin and Davis[1] have estimated energy

[1]G. M. Blouin, and C. H. Davis, "Energy Requirements for the Production and Distribution of Chemical Fertilizers in the United States" (Paper presented at Southern Regional Education Board Meeting, Atlanta, Georgia, October 1975), p. 98.

Table 30. Total Energy Requirements for Production of Fertilizers in the United States

	Quantity (tons x 10^6)	Energy Requirements (BTU x 10^6)	(BTU x 10^{12})
Materials and Intermediates Nitrogen[a]			
Ammonia	9.1	42	382.2
Solid Urea[b]	(0.7)	7	4.9
Urea Solution[b]	(0.7)	3	2.1
Solid ammonium nitrate[b]	(1.3)	8	10.4
Ammonium Nitrate Solution[b]	(0.7)	4	2.8
Subtotal, Nitrogen	9.1		402.4
Phosphate[a]			
Wet-process acid	4.4	10	44.0
Triple superphosphate[b]	1.7	1	1.7
Granular ammonium phosphate	2.7	1	2.7
Ammonium polyphosphate solution[b]	0.5	5	2.5
Normal Superphosphate	0.3	2	0.6
Subtotal, Phosphate	5.2		51.5
Potassium[a]			
Potassium Chloride	2.5	4	10.0
Subtotal, Materials and Intermediates			463.9

[a]Per ton N, P_2O_5, or K_2O.

[b]Does not include the energy required to produce the intermediates.

Source: G. M. Blouin, and C. H. Davis, "Energy requirements for the Production and Distribution of Chemical Fertilizers in the United States." Presented at Southern Regional Education Board Meeting, Atlanta, Georgia, October 1975, P. 324.

required for transportation of fertilizer raw materials and intermediates and distribution of products. The energy requirements for different modes of transportation in BTU/ton material are: truck, 2400; rail, 670; barge, 550; pipeline, 450.

The estimated total annual energy requirement for transportation of raw materials for fertilizer manufacture is 5.3×10^{12} BTU, of which nitrogen and phosphate account for 0.7 and 4.6×10^{12}, respectively. Estimates of the energy required for transportation of fertilizers are given in Table 31. The total for all products and all forms of transportation is 30.2×10^{12} BTU. Of this total, truck and barge transportation account for 11.9 and 10.8×10^{12} BTU, respectively.

Field application. The estimated energy required for field application, which is summarized in Table 32, totals 9.4×10^{12} BTU per year.

From the estimates given in Table 32, there is an attempt to then estimate the approximate energy usage in fertilizer application for selected crops (Table 33) as follows:

Estimates of energy requirements:

N: (a) Production of N/ton = 64 BTU x 10^6

(b) Transportation of N/ton = 0.63 BTU x 10^6

(c) Field Application of N/ton = 0.9 BTU x 10^6

Table 31. Fertilizer Mode of Transportation, and Estimated Average Transport Mileage and Total Energy Consumption

Type of Product	Quantity (Tons x 10^6)	Quantity Transported (Tons x 10^6)			
		Rail	Barge	Pipeline	Truck[a]
Direct Application Materials					
Anhydrous ammonia	3.8	0.6	2.1	1.1	3.8
N solution	4.7	2.2	2.5	--	4.7
Urea pills	1.1	0.6	0.5	--	1.1
Ammonium nitrate pills	4.2	2.7	1.5	--	4.2
Phosphates	3.8	2.3	1.5	--	3.8
Potash	4.5	3.0	1.5	--	4.5
Mixtures	25.0	10.0	15.0	___	25.0
Total	47.1	21.4	24.6	1.1	47.1
Estimated transport Mileage		500	800	600	105
Estimated Energy Consumption (10^{12} BTU)		7.2	10.6	0.3	11.9

Source: Handbook of Energy Utilization/USDA, Energy in Agriculture.

[a]Practically all fertilizer transported by rail, barge, or pipeline must reach its ultimate destination by truck. Therefore, there is an undetermined amount of "double-counting" involved.

Table 32. Field Application Energy Requirements[a]

Type of Material	BTU x 10^6/Ton Product	Total (BTU x 10^{12})
Anhydrous ammonia	0.7	2.5
Nitrogen solutions	0.2	0.9
Fluid Mixtures	0.2	0.7
Solid Products	0.2	5.3
TOTAL		9.4

[a]Estimated figures from USA energy use database compiled mostly in 1974-1979.

Source David Pinentel (Ed.), Handbook of Energy Utilization Agriculture (Florida: CRC Press Inc., 1980).

Table 33. Estimated Energy Used in Fertilizer Application on Selected U.S. Field Crops

Crop, Years	Total Harvested Acreage (Million Acres)	Harvested Acres Receiving (%)			Application Rates (lb/acre)			Energy Used Per Acre (BTU x 10^6)[a]			Estimated Total Used Per Acre (BTU x 10^6)[b]	Total Energy Used (BTU x 10^7)[c]
		N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O		
Corn for Grain												
1980	73.0	96	87	81	130	66	86	3.8	0.6	0.2	4.6	33.4
1981	74.5	97	90	84	137	67	86	4.1	0.6	0.2	4.9	36.5
1982	72.7	97	88	84	135	65	86	4.0	0.6	0.2	4.8	34.9
1983	51.5	96	88	83	137	64	85	4.1	0.6	0.2	4.9	25.2
1984	71.8	97	87	82	138	65	87	4.1	0.6	0.2	4.9	35.1
Cotton												
1980	13.2	71	48	30	72	46	46	2.1	0.4	0.1	2.5	3.3
1981	13.8	75	52	30	72	46	46	2.1	0.4	0.1	2.5	3.5
1982	9.7	71	41	30	82	46	55	2.4	0.4	0.1	2.9	2.8
1983	7.3	68	44	30	81	45	52	2.4	0.4	0.1	2.9	2.1
1984	10.5	76	48	32	81	48	53	2.4	0.4	0.1	2.9	3.0
Soybeans												
1980	67.8	23	35	36	17	46	70	0.5	0.4	0.2	1.1	7.4
1981	66.2	21	33	35	18	46	76	0.5	0.4	0.2	1.1	7.3
1982	69.4	17	27	29	17	43	68	0.5	0.4	0.2	1.1	7.6
1983	62.5	20	30	32	18	45	70	0.5	0.4	0.2	1.1	6.9
1984	66.1	20	30	32	17	46	72	0.5	0.4	0.2	1.1	7.3

Table 33. Continued

Crop, Years	Total Harvested Acreage (Million Acres)	Harvested Acres Receiving (%)			Application Rates (lb/acre)			Energy Used Per Acre (BTU x 10^6)[a]			Estimated Total Used Per Acre (BTU x 10^6)[b]	Total Energy Used (BTU x 10^7)[c]
		N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O		
All Wheat												
1980	71.1	67	43	18	58	39	40	1.7	0.4	0.1	2.2	15.6
1981	80.6	70	47	20	58	39	47	2.7	0.4	0.1	2.2	17.1
1982	77.9	70	45	18	59	37	41	1.7	0.4	0.1	2.2	17.1
1983	61.4	72	48	20	60	39	48	1.7	0.4	0.1	2.2	13.5
1984	66.9	76	49	17	62	37	46	1.8	0.3	0.1	2.2	14.7

NOTE: The gross energy calculations contain many assumptions, and therefore, are not highly accurate. The energy requirements presented represent the average or generalized situation and actual energy consumption in specific situations can vary significantly from the calculations in this study. The calculations are based on the fact that the identified fertilizers for estimation are the principal component of every day fertilizer usage and consume most, if not all, the energy involved.

[b]Estimated Energy used per acre for fertilizer = Energy for N + Energy for P_2O_5 + Energy for K_2O

[c]Estimated Total Energy used = Estimated total used per acre x total acreage treated.

Total for N/ton = a + b + c = 65.53 x 10^6 BTU

P_2O_5: Production of P_2O_5/ton = 19 BTU x 10^6

Transportation of P_2O_5/ton = 0.63 BTU x 10^6

Field Application P_2O_5/ton = 0.2 BTU x 10^6

Total for P_2O_5/ton = 19.83 BTU x 10^6

K_2O: Production of K_2O/Ton = 4 BTU x 10^6

Transportation of K_2O/ton = 0.63 BTU x 10^6

Field Application of K_2O/ton = 0.2 BTU x 10^6

Total for K_2O/ton =4.83 BTU x 10^6

The use of energy in procuring and usage of fertilizer for crop production in the U.S. is about levelling off after a notable rise in the trend of use for recent years (Table 33). Most especially, for the selected crops, energy use per acre has relatively levelled off despite increased acreage being fertilized and harvested. There was an increase in fertilizer use in the past relative to the growth rate of use in recent years which are now leveling off (Figure 11). Nonetheless, there are still needs for improvements in fertilizer usage and conservation of energy, through use of more efficient technology and techniques. More than 45% of the total energy needed on farms is for fertilizer production and delivery, hence total energy savings on farms, depend on proper fertilizer application and efficient use.

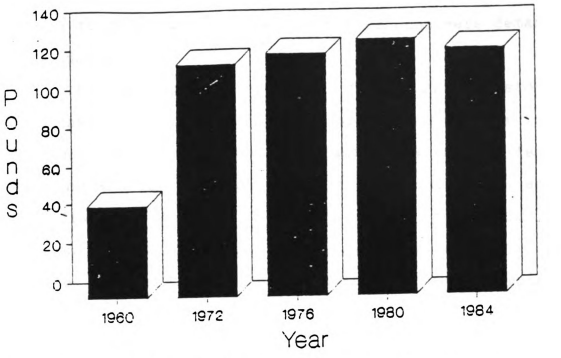

Figure 11. USA Fertilizer Use Per Acre Increased in the 1970's But Now Levelling Off

Source: USDA--Agriculture Statistics, Various Years.

Livestock Production

Livestock production in the United States uses over 13,400 BTU of direct energy each year, and the figure does not include indirect energy inputs such as the energy required to make fertilizers and pesticides used in feed production.[1] Although livestock production is not a net energy producer as some crops, such as corn, it plays an important role in agriculture and it will

[1]B. A. Stout, et al., Energy Use and Management in Agriculture (North Scituate, MA: Breton Publishers, 1984).

continue to play such a role as long as consumers demand meat products.

The average energy use for U.S. livestock operations, including dairy, is displayed in Figure 12. The major energy inputs are feed handling with 29%, feed processing and distribution (21%), farm travel (20%), and waste disposal (11%). However, there could be a variation in such breakdown of energy use, depending on the type of operation under discussion. For example, feed processing and distribution can account for almost 50% of the energy requirements for a beef cow/calf

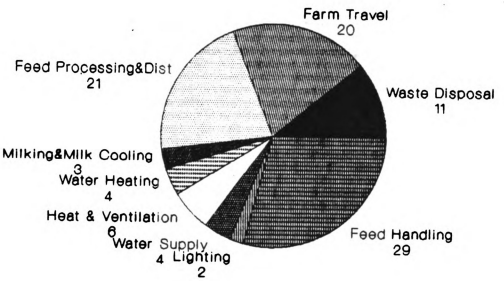

Figure 12. Use of Energy in U.S. Livestock Production Processes

Source: B. A. Stout, et al., Energy Use and Management in Agriculture (North Scituate, MA: Breton Publishers, 1984).

operation, and as little as 10% for a hog farrow-to-finish operation.[1]

The percentage total energy consumption of various energy sources for all U.S. livestock operation is shown in Figure 13. As can be seen, gasoline is used most, followed by diesel fuel, LP gas, and electricity, because it takes almost three units of primary energy of all other energy sources to make one unit of electricity,

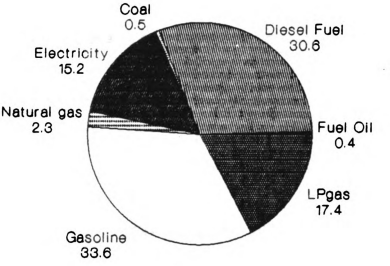

Figure 13. Percentage Distribution of Total Energy Used in Livestock Production in the U.S.

Source: "Energy Statistics and Balances," UN Publication 1985, with percentage estimates by author.

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[1]B. A. Stout, et al. Energy Use and Management in Agriculture (North Scituate, MA: Breton Publishers, 1984.

electrical equipment is ultimately the largest energy user.

The average farm size has increased (Table 6), and farms have become more specialized, and there is an increasing use of more intensive production system. Such adaptation to increased intensive productive systems, especially in specialized production systems, such as dairy and poultry, means increased energy consumption and a need for efficient production methods to better consume farm energy.

Energy use per head of poultry for production activities has declined slightly since the mid-1960s and considerably since the 1940s,[1] as more efficient use of heating fuels, particularly for broilers, was more than sufficient to offset large requirements for electricity, particularly for layers and turkeys.[2]

Rates of energy use per 1000 birds varies greatly with types of poultry (Table 34) and among regions. Climatic conditions and seasonal variations in temperature caused some differences, but these were often

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[1]David Pimentel, Ed., Handbook of Energy Utilization in Agriculture (Boca Raton, FL: CRC Press, Inc., 1980), p. 379.

[2]Edward C. Cook, The Soviet Livestock Sector--Performance and Prospectus (Washington, D.C.: Publication of the United States Department of Agriculture, Foreign Agricultural Economic Report #235, 1988), p. 5.

Table 34. U.S. Average Energy Use per 1,000 Birds

Type of Poultry	Natural Gas (m^3)	Fuel Oil (l)	Coal (t)	Gasoline (l)	Diesel Fuel (l)	Electricity (kwh)	Propane (l)
Broilers	21.2	8.1	0.006	7.85	--	168.5	154.8
Turkeys	250.6	14.5	0.04	153.1	46.5	509.5	1222.3
Hens	24.8	6.6	--	91.8	23.7	2893.1	67.4
Chickens	53.9	15.8	0.02	75.6	11.7	50.1	312.7
Other Poultry	410.9	27.4	0.05	78.8	--	61.6	208.9

Source: David Pimentel, ed., Handbook of Energy Utilization/USDA--Energy in Agriculture, 1974, in Agriculture (Baca Raton, FL: CRC Press, Inc., 1980).

modified by housing design, types of equipment, and alternative management practice.

There is considerable room for improvement in the use of energy in the poultry industry. It is not unusual, as given in many literature sources and in reports of regional analysis of energy uses, to find some producers using twice as much energy per 1000 birds as other producers.[1] These variations may be due to types of housing, mechanization, elevation, windbreaks, management, and perhaps other factors. Better insulation by use of new types of insulating materials, better control of ventilation, reuse of heat dissipated from ventilation and processing, a movement back to more basic foods with less further processing, a reexamination of irradiation preservation, newer shipping and transportation procedures to improve shelf-life, and changes in retail marketing procedures could possibly save large amounts of energy.

The USSR

Though the importance of both the agricultural and energy sectors of the Soviet Union is well recognized in the overall picture of the economy as a whole, the

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[1]G. Stanhill, Energy and Agriculture (New York: Springer-Verlage-Beslin-Heidelberg, 1984); and most general other USDA technical reports and publications.

critical linkages between these two sectors are not often analyzed in existing literature or research efforts. Soviet energy and agriculture have individually on their own merits received a great deal of attention from Western analysts in recent years. Despite the heightened attention paid to the individual sectors of energy and agriculture, little discussion has been made of the full range of relationships between the two sectors.

Crop Production--Irrigation

The amount of irrigated land brought into production has increased for several years (Table 35). Investment funds in agriculture is on the decrease, so for such capital outlay as irrigation, it could well continue to decrease. The investment decline in 1989 was to decrease land improvement's share of total capital investment to 15 percent, from 17 percent in 1988.[1] Compared to 1987, 1988's irrigated land commissioned dropped 27 percent.[2] Soviet figures illustrate the need for improvement. On 15 percent of the farms, irrigating grain, the yields are less than 1.5 tons per hectare.[3]

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[1]USSR, Agriculture and Trade Report, Situation and Outlook Series (Washington, D.C.: USDA Publication, Report #RS-909-1 May 1990), pp. 14-15.

[2]Ibid, p. 15.

[3]Ibid., p. 16.

Table 35. USSR Irrigation Trends from 1970-1988.

Year	Harvested Acreage (Million Acres)	Irrigated Acreage (Million Acres)	Percent Share Irrigated
1970	560	16.4	3
1975	565	36.1	1
1980	567	43.2	8
1981	567	45.0	8
1982	567	46.5	8
1983	569	47.8	8
1984	569	48.2	8
1985	569	50.0	8
1986	570	51.3	8
1987	570	51.3	9
1988	570	52.0	9

Source: Soviet Government Statistics.

This yield is 15-30 percent less than what might be expected on irrigated land in California, depending on whether output is small grains or corn. Soviet yields on irrigated land were less than 7.5 tons per hectare on a fourth of farms growing potatoes and on a third of the farms producing vegetables.[1] California yields are 40-plus tons per hectare.

Energy, Fertilizer, and Grain Production

In the Soviet Union, 95% of nitrogen fertilizer is manufactured from natural gas.[2] One of the most important inputs in Soviet agricultural production is nitrogen fertilizer, but in recent years, there has been a major problem with that. The agricultural sector has been plagued with chronic fertilizer shortages, lateness in delivery of available supplies. According to the USDA, serious production difficulties arose in the chemical industry in 1979 which marked the first in 25

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[1] Ibid., p. 15.

[2] J. S. Auburn, and B. Young, Energy, Fertilizer, and Grain Production in the U.S.S.R.: Key Linkages (Boulder, CO: Westview Special Studies, 1983), p. 145.

years that Soviet fertilizer production was unable to record an increase.[1]

The Soviet Union is one of the world's leading exporters of ammonia, the most important ingredient in production of Nitrogen fertilizer, which makes it surprising why Soviet agriculture should suffer from shortages of fertilizer. According to Auburn and Young, Soviet sales of ammonia to the United States have generated considerable controversy as, of course, have U.S. sales of grain to the Soviet Union.[2]

In 1988, Soviet mineral fertilizer output exceeded the production of the United States, France, West Germany, and Great Britain combined.[3] A large amount of this production is exported, but partly because of continued flaws in the fertilizers' quality, composition, and allocation, farm production continued to respond disappointingly.

Soviet mineral fertilizer output reached 37.1 million tons in 1988, although the growth rate was the

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[1]USSR, Agriculture and Trade Report, Situation and Outlook Series (Washington, D.C.: Publication of the U.S. Department of Agriculture, August 1989), p. 35.

[2]J. S. Auburn and B. Young, Energy, Fertilizer, and Grain Production in the U.S.S.R.: Key Linkages (Boulder, CO: Westview Special Studies, 1983), p. 145.

[3]USSR, Agriculture and Trade Report, Situation and Outlook Series (Washington, D.C.: Publication of the U.S. Department of Agriculture, August 1989), p. 13

lowest in several years (Table 36). At the same time, deliveries of mineral fertilizers to farms declined by 1.1% (312,000 tons) reducing the ratio of deliveries to fertilizer production as earlier pointed out.

Overall, the use of mineral fertilizers increased 2.6 times from 1970 to 1987. Application rates per acre of sown area approached 642 pounds in 1986, compared to the U.S. rate of 500 pounds approximately. The average Soviet application rate first exceeded the U.S. rate in 1983.[1]

The economic effectiveness of agricultural chemical has been disappointing and their increased application has been subject to rapidly diminishing returns as evidenced in production figures from Tables 14 and 15. Although there have been advances in several areas, there are many complaints about the Soviet fertilizer industry's production.

Grain production is chosen for discussion and analysis in this study, based on the importance of grain in Soviet agricultural production and trade. The role of grain cannot be overemphasized as far as the Soviet Economy is concerned, and it is referred to as the "Achilles Heel" of the Soviet economy. The result of majority of total crop production is a direct reflection

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[1]Ibid., p. 15.

Table 36. Production and Deliveries of Mineral Fertilizers to Agriculture, USSR (1000 metric tons)

Year	Total	Nitrogen	Phosphate	Ground Phosphate Rock	Potash	Trace Elements
Production						
1966-70 Average	10,379	4,210	2,030	955	3,177	7
1971-75 Average	17,877	7,248	3,451	1,032	6,138	8
1976-80 Average	23,328	9,283	5,300	828	7,910	7
1981-85 Average	29,294	12,573	6,747	774	9,192	8
1986	34,737	15,200	8,540	788	10,200	9
1987	36,300	15,700	8,900	791	10,900	9
1988	37,100	16,000	9,100	801	11,190	9
Deliveries						
1966-70 Average	8,452	3,520	1,847	857	2,221	7
1971-75 Average	13,802	6,209	2,978	904	3,703	8
1976-80 Average	18,063	7,632	4,460	827	5,137	7
1981-85 Average	22,156	9,790	5,76	774	5,817	9
1986	26,514	11,475	7,567	787	6,677	8
1987	27,412	11,787	7,800	764	7,052	9
1988	27,100	11,700	7,700	787	6,904	9

Source: USDA-USSR Agriculture and Trade Reports, Situation and Outlook Series, various years (Washington, D.C.: Publication of USDA, Economic Research Service), 1989.

of the performance of grain production, and also, the critical stages of livestock production, feeding, is dependent on the grain output and procurement for the livestock sector to function properly. Additionally if one can paint a clear picture of the effect of fertilizer use on grain production in the USSR, a case could be made that the output of other Soviet crops would respond similarly to similar fertilizer inputs at the margin as would grain. In most cases, one would refer to a crop type, mostly wheat, since it accounts for almost half of Soviet grain production, or barley, a feed grain of increasing importance in recent years. Together, wheat and barley generally account for three-quarters of Soviet grain production.[1]

The available Soviet data are often in terms of total fertilizer and not disaggregated by nutrient type. Any attempt at estimating Soviet energy usage with regard to fertilizer production must, of necessity, be based upon limited data and simplifying assumptions. Several Soviet, as well as Western sources, have made reference to the deteriorating Soviet fertilizer situation, yet no systematic analysis of fertilizer production and supply to agriculture is available.

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[1]Ibid., p. 23.

The analysis of Soviet fertilizer delivered to agriculture and applied to grain is further compounded by the absence of data on specific application rates to certain crops, such as wheat, barley, etc. Figures for fertilizer applied specifically to grain crops have been made available only in recent years.

Interestingly, though, from the point of analyzing the linkage between the agriculture and energy sector, ammonia fertilizer plays a vital role. It is manufactured primarily from natural gas both in the USSR and the USA. Ammonia is the general starting point in the production of most nitrogen fertilizers. The situation with natural gas production in the USSR has been discussed earlier. While future production will depend heavily on the development of sufficient infrastructure (vis-a-viz, production of most nitrogen fertilizers), natural gas that might be converted to ammonia represents a small fraction of Soviet total gas production, may be in the order of 4 to 5%.[1] It may be that problems in natural gas distribution are responsible for some of the shortfalls in fertilizer production and

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[1]J. S. Auburn, and B. Young, Energy, Fertilizer, and Grain Production in the U.S.S.R.: Key Linkages (Boulder, CO: Westview Special Studies, 1983), p. 163.

usage in the USSR, due to feedstock delivery problems as mentioned by the USDA in their various situation reports on Soviet agriculture.

Although there have been advances in several areas, there are a lot of complaints about the Soviet fertilizer industry's production. About 90% of production is now compounded and concentrated and 60% is granulated. The average nutrient content in manufactured fertilizer, which was only 38.4% in 1980, had risen to 42% in 1987.[1]

Practically all soluble nitrogen and phosphorus fertilizers are supplied to farms in granulated form. However, farmers complained about their moisture content, caking, and granular strength. A report written in 1988 noted that nitrogen fertilizer caked badly in storage, and that granules of carbomide and ammonium nitrate and various compounds were weak and nonuniform.[2]

A waste in the production procedure or wasteful transportation or application of fertilizer constitute a direct and indirect waste of the energy resources inputted into these processes. Effective levels of waste

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[1]USSR, Agriculture and Trade Report, Situation and Outlook Series (Washington, D.C.: Publication of the USDA, ERS, 1989), p. 17.

[2]Khimicheskaya Promyshlenost (USSR Government Publication, 1988), pp. 2-5.

in energy would have been estimated, but there is no available breakdown of Soviet energy use in different stages of either production, transportation, or application of fertilizers.

Nonetheless, a comparison of the production figures in Table 37 of the USSR and the USA shows that the Soviets, in spite of their enormous potentials for chemical fertilizer production and relatively higher need for its use, lagged behind the USA for many years, but are currently producing on the average, almost double the production figures for the USA (Table 37). The production of Potash and Nitrogen fertilizers have risen very sharply in recent years to surpass the U.S.A., and it is still on a steady increase of about 5 to 8% annually estimated from by records of the 1980s.

In the past, it is evident from Table 38 that the U.S. farmers started early to adopt fertilizer faster than their Soviet counterparts. The level of consumption of chemical fertilizers as shown in Table 38 by nutrient content is almost stable in the U.S. now and levelling off after a sharp increase in the 1960s and 1970s.

Consumption in the Soviet Union is also rapidly catching up to the U.S.A. level after a very slow start and in some cases, level of usage of various chemical fertilizers tend to surpass that of the U.S.A. (Table 38). Overall, the use of chemical fertilizers increased

Table 37. Comparison of Chemical Fertilizer Production (Nutrient Content 1960-1986) ('000 metric tons) (1960-1986).

	1960	1970	1975	1980	1982	1983	1984	1985	1986
Chemical Fertilizer Production									
USA	7,410	15,789	18,221	23,377	17,653	19,955	21,508	17,462	NA
USSR	3,281	13,099	21,998	24,762	26,738	29,733	30,808	33,194	34,700
USSR as % of USA	44	83	121	106	151	149	143	190	--
Phosphate (P_2O_3)									
USA	2,626	5,369	6,531	6,265	6,363	7,734	8,400	6,680	NA
USSR	1,192	3,585	5,500	6,455	7,057	7,417	7,695	8,596	9,100
USST as % of USA	45	67	84	103	111	96	92	129	--
Potash (K_2O									
USA	2,045	2,259	2,099	2,052	1,639	1,470	1,414	1,098	NA
USSR	1,084	4,087	7,944	8,064	8,079	9,294	9,776	10,367	10,400
USSR as % of USA	53	181	378	393	493	632	691	944	--
Nitrogen (N)									
USA	2,739	8,161	9,591	11,825	9,051	10,750	11,694	9,864	NA
USSR	1,003	5,423	8,535	10,241	11,241	13,014	13,328	14,223	15,200
USSR as % of USA	37	66	89	87	128	121	114	144	--

Source: Alan P. Pollard, Ed., USSR Facts & Figures (Gulf Breeze, FL: Annual Academic International Press, 1989), Vol. 13.

Table 38. Comparison of Chemical Fertilizer Consumption, Nutrient Content (Kilogram per hectare of arable land)

	1960	1970	1975	1981	1981	1982	1983	1985	1985
Chemical Fertilizer									
USA	38.9	80.9	90.0	112.7	102.0	86.7	104.5	103.9	94.1
USSR	11.2	44.3	74.0	80.9	82.6	86.7	98.7	99.1	108.9
Nitrogen (N)									
USA	2,749	7,379	9,445	10,817	9,964	8,280	10,063	10,436	9,473
USSR	769	4,605	7,339	8,262	8,383	9,038	10,292	10,279	10,950
Phosphate (P_2O_3)									
USA	2,488	4,358	4,742	4,930	4,367	3,754	4,446	4,210	3,770
USSR	1,088	3,133	4,728	5,590	5,879	6,115	6,454	6,625	7,615
Potash (K_2O									
USA	1,967	3,839	4,726	5,733	5,108	4,383	5,259	4,999	4,561
USSR	766	2,574	5,176	4,904	4,905	4,991	6,200	6,167	6,822

Source: Alan P.Pollard, ed., USSR Facts & Figures (Gulf Breeze, FL: Annual Academic International Press, 1989), Vol. 13.

2.5 times from 1970 to 1985 in the USSR as noted in Table 38. Application rates per hectare of arable land approached 109 kilograms in 1985, compared to the U.S. rate of 94. The average Soviet application rate first exceeded the U.S. rate in 1985. Fertilizer application rates tend to be higher in Western Europe, where fertilizer is more effective because of the climate than in the U.S.S.R.[1]

More than 80% of Soviet plowland is poor in phosphates. Still, Soviet commentators note that only an average of 30 kilograms of phosphorus fertilizers is applied per hectare, whereas West European countries use two to three times that amount.[2]

The USSR is not known to have a good natural endowment of phosphate ores. Most phosphates ore now come from deposits whose facilities still lack sophisticated ore-enriching equipment. After encouraging industry to produce complex mixed fertilizers in the past, plans now call for production increase over the next few years to consists entirely of single-element fertilizers. This is due to the preference to custom mix

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[1]USSR, Agriculture and Trade Reports, Situation and Outlook Series (Washington, D.C.: Publication of USDA ERS, 1989, p. 12.

[2]Vestnik, Soviet Annual Publication (Moscow, USSR, 1987, p. 53.

fertilizers in the field for more exact specifications and needs.[1]

Soviet publications continue to emphasize a number of problems. Liming is acknowledged to improve the efficiency of Chemical fertilizers by 30 to 40%,[2] yet the transportation, storage, and application of lime are very inadequate.

The inadequate supply of chemicals and the means to store and apply them hamper modernization as evident in most reports. Even the high priority fields are not well supplied. As noted in Pravda, a Soviet newspaper publication,

> In accomplishing all tasks for increasing the productivity and stability of grain farming, the Ukraine counts on assistance on the part of the USSR Gosagroprom which has thus far been assigning absolutely insufficient equipment and chemical preparations even for the area under intensive technologies.[3]

The implication for this rise in trend in fertilizer needs and demand relative to the U.S.A. implies that more energy usage will be needed to procure and fulfill such rising needs. Since natural gas is the main energy source for usage, one does not foresee much

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[1]USSR, Agriculture and Trade Report, Situation and Outlook Series (Washington, D.C.: Publication of the USDA, ERS, 1989), p. 13.

[2]Ibid., pp. 22-23.

[3]Pravda, 4 March 1987.

of any immediate problem in meeting these needs in energy usage as far as the USSR natural gas supply is concerned. Nonetheless, there is a need to attempt at conserving fertilizer wastage per hectare and hence bring it to reasonable level or par with the U.S.A. This can be accomplished through better technology usage.[1] Energy savings on Soviet farms, in major part, depend on proper fertilizer application and efficient use.

Farm Machines and Equipment

Perhaps the most amazing gap in all the input-output data with respect to energy use in Soviet agriculture is the lack of information from surveys of the stock and type of farm machinery available. Regional availability of some very important data on major kinds of machinery and the time of their manufacture would have enabled one to do an estimate of the power consumption relative to Western standards, and consequently, provide a useful estimate of the energy needs of such machines. These data may help construct a benchmark, but more detailed data are necessary, such as the efficiency of tractors and capacity of combines. Even such data are not currently compiled in the Soviet Government

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[1]Energy "savings" can be made both before the fertilizer is applied (during production, transportation, etc.), and if applied correctly.

Statistical series, and past available data are too old for use in making reasonable estimate of current trends.

Tractors and combine deliveries declined for four consecutive years (Table 39). Tractors, combines, and other agricultural equipment are known to spend more time in repair shops than in the fields.[1] In 1989, 15-20 percent of the tractors and trucks in agriculture were out of service.[2] The standard life span of Soviet tractors is only 8 to 10 years; according to the Soviets, this is at least one and a half times less than in the U.S.[3] About 300,000 tractors are written off annually, 25 percent of them before expiration of the standard life cycle.[4]

Problems with on- and off-farm transportation of agricultural products worsened in recent times. The Soviets reported that 1.5 million tons of gasoline and 0.6 million tons of diesel exports were foregone in the third quarter of 1985,[5] and instead, transferred to

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[1]Vestnik Afropama, No. 31 (1989).

[2]USSR Goskomstat, Press Release No. 604, December 26, 1989.

[3]USSR, Agriculture and Trade Report--Situation and Outlook Series (Washington, D.C.: USDA Publication, Report # RS-90-1, May 1990), p. 13.

[4]Ibid., p. 14

[5]Ibid, pp. 14-15.

Table 39. Indicators of Inputs and Productivity in Soviet Agriculture, 1960-1987

	Units of Measurement	1960	1970	1980	1985	1986	1987	1988
Tractors	10^3	1038	1844	2646	2830	2844	2759	2692
Grain Combines	10^3	476	586	699	804	805	774	751
Trucks	10^3	631	860	1147	1327	1348	1350	1354
Electric Power	10^9 KWT/h	10.0	38.6	110.9	145.7	152.1	160.4	166.8
Fertilizer Deliveries	10^6 Tons	2.6	10.3	18.8	25.4	26.5	27.4	27.2
Irrigable Land[a]	10^6 ha	9.4	10.8	17.2	19.7	20.2	20.1	20.5
Drained Land[a]	10^6 ha	7.8	7.4	12.6	14.6	14.9	14.9	14.9
Investment	10^9 rubles	6.1	16.0	29.8	31.5	33.5	34.4	35.1
Agricultural labor[b]	10^6 people	25.8	24.1	22.9	22.4	22.0	21.3	21.0
Gross Agricultural Output	10^9 rubles	78.7	108.4	122.0	135.2	142.8[c]	142.8	140.0[c]

[a]For agricultural use.

[b]Socialized sector only.

[c]Volume in 1973 prices adjusted and derived using 1983 prices, with conversion coefficient of 0.65 given for gross agricultural output. For annual average during 1981-1985, and 1985, see Narkhoz 1987, pp. 180-181, Narakhoz 1987, p. 174.

Sources: Narodnoe Khozyaistvo SSSR, various issues.

domestic agricultural use. Still, deliveries of fuels and lubricants to agriculture apparently were curtailed, which hampered the harvest. It is officially estimated that gasoline supplies for agriculture will remain stable in 1990.[1]

In comparing technology, one will assume that farm machinery and equipment demand a great deal of the total farm energy usage. The figures shown in Tables 40 and 41 indicate that more tractors and lorries (trucks) are used on the average on U.S. farms with greater engine capacity. This, in turn, demands more and greater energy usage. In considering the figures for relative tractor usage and power demand per acreage of harvested crop area (Tables 40 and 41), there is an indication that more energy is used in the USA per harvested acreage. The output figures for crop production is also more in the USA on a relatively smaller acreage of crop harvested. This is an indication of the degree of mechanized farming in the USA relatives to the USSR where more human labor is still being used in agricultural production instead of the machines. Relatively lower energy usage in grain production as indicated in the smaller number of grain combines used per thousand acres of harvested grain areas (Tables 40 and 41) in the USA as compared to the USSR, is

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[1]Ibid., p. 13.

Table 40. Selected Farm Machinery and Equipment and Tractor Horspower: USSR 1940-1986 (End of Year Figures)

	1940	1960	1970	1980	1985	1986
Tractors ('000 units)	530	1122	1977	2462	2798	2854
Aggregate Capacity of Tractor Engines (mn horsepower)	18	48	112	191	232	239
Grain Combines ('000 units)	182	497	623	722	832	849
Lorries ('000 units)	228	760	1136	1596	1851	1908
Aggregate load carrying capacity ('000 tons)	479	1978	3327	5828	8048	8530
No. of Tractors per '000 acre harvested crop area (units)	0.09	0.20	0.35	0.50	0.55	0.55
Average Tractor Horse-power per '000 harvested crop area (mn horsepower)	1.62	9.6	39.2	95.5	127.6	131.5
No. of Grain Combines per '000 acre Harvested Grain Area (units)	0.61	1.65	2.03	2.28	2.77	2.95

Source: Soviet Government Statistics, Various Years.

Note: Data in this table differs slightly from data in Table 39 due to different methods of enumeration by different authors.

Table 41. Selected Farm Machinery and Equipment and Tractor Horsepower, United States: 1973-1986 (End of Year Figures).

	1975	1980	1985	1986
Tractors (exclusive of steam and garden) ('000 units)	4469	4752	4676	4670
Aggregate capacity of tractor engines (mm horsepower)	222	304	311	311
Motor Trucks ('000 units)	3032	3344	3380	3380
Grain Combines ('000 units)	524	652	643	640
No. of tractors per '000 acres harvested crop area (units)	1.33	1.35	1.37	1.44
Average Tractor Horsepower per '000 harvested crop area (mm horsepower)	295.3	410	426	447
No. of Grain Combines per '000 acre harvested grain area (unit)	1.62	1.94	1.95	2.06

Source: USDA, Agricultural Statistics for various years.

an indication of perhaps better farm machinery and equipment usage and energy conservation toward better machine efficiency. The Soviets could further close this indication of a "performance gap" by modernizing their fleet of farm machinery and equipment to increase the energy efficiency of the machines and consequent usage for crop production.

In general, if one compares procedures with the situation in the U.S.A. and the USSR and assume energy usage to be at least similar, the deduction will be in this general frame:

It is known that more than 45 percent of the total energy needed on farms is for fertilizer production and delivery. Hence without much emphasis, it is only correct at this juncture to reiterate the fact that total energy savings on farms, depend on proper fertilizer production, efficient delivery systems, proper application and efficient use.

Coupled with these needs for efficient fertilizer production and usage are the need to adequately control for other factors that could greatly enhance better farm production and efficiency. Some of these factors include use of appropriate and improved crop varieties, weed

control, better farm management, and organization. These will help to reduce further wastages of farm resources and, consequently, energy savings. Fertilizer production and usage, irrigation, and use of farm machines and equipment have been singled out for analysis because they require a great percentage of the energy used on farms relative to these other stated factors. Consequently, anything that affects crop production level in general is bound to eventually affect livestock production and its overall input/output ratios.

Livestock Production

The strategy in USSR livestock sector focuses on achieving growth through greater output per head, and on improvements in production efficiency. This approach makes sense considering that the average daily rate of gain for Soviet cattle and hogs is only about 50 to 60% of the U.S. level and that Soviet milk yields per cow are less than half those in the U.S.[1] There has been some improvement in these areas in recent years. These improvements are the results of increased feed available per animal, some increases in feed quality and breed

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[1]Edward C. Cook, The Soviet Livestock Sector--Performance and Prospectus (Washington, D. C.: Publication of the United States Department of Agriculture, Foreign Agricultural Economic Report #235, 1988), p. 3.

improvement work, particularly for cows.[1] The rise in animal productivity has, at least temporarily, halted the longer term trends of increasing costs of production for major livestock products in general. After significant gains in 1986, there has been virtually no improvement in feeding efficiency in 1987, except for broilers according to USDA reports.[2] There are no breakdowns of estimated energy uses in livestock production procedures in the USSR, but indications of production levels and efficiency of production, relative to the USA, still leaves much to be desired on the part of the USSR.

Nonetheless, just like in the USA, livestock production in the USSR uses a large amount of energy both in indirect energy inputs, such as the energy required to make fertilizers, herbicides and pesticides used in crop production and plant harvest, feed production and storage as well as in use of farm machinery and equipment.

The availability of machines in Soviet livestock production on the average is low compared to the USA. Figures in Tables 42 and 43 indicate that there are more tractors available per thousand pounds production of livestock and livestock products in the USA compared to

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[1]USSR, Agriculture and Trade Report, Situation and Outlook Series (Washington, D.C.: Publication of USDA, ERS, 1989), p. 30.

[2]Ibid., p. 37.

Table 42. Average Number of Tractors and Tractor Horsepower in Livestock Production: USSR 1985-1987.

Livestock and Livestock Product	Average Number of Tractors per '000 Lbs. Production[a] (Units)			Average Capacity of Tractor Engines per '000 Lbs. Production[b] (mn. Horsepower)		
	1985	1986	1987	1985	1986	1987
Cattle	0.03	0.03	0.03	7.84	7.84	7.84
Hogs	0.16	0.16	0.16	37.12	38.24	38.25
Poultry	0.45	0.42	0.40	104.4	100.4	100.2
Milk	0.02	0.02	0.02	4.64	4.78	4.79
Eggs ('000)	0.05	0.04	0.04	11.60	9.56	9.56

[a]For cattle and hogs, the quantity of net production is the slaughter weight reported during the year, with adjustments for number of animal head in inventory.

[b]Average number of tractors used per 1,000 lbs. production x aggregate capacity of tractors engines from Table 40.

Source: USSR Government Statistics, various years. Calculated from Vesnik Statistiki, various issues.

Table 43. Number of Tractors and Tractor Horsepower in Livestock Production--USA 1985-1987

Livestock and Livestock Product	Average Number of Tractors per '000 Lbs. Production[a] (units)			Average Capacity of Tractor Engines per '000 Lbs. Production[b] (mn. Horsepower)		
	1985	1986	1987	1985	1986	1987
Cattle	0.12	0.12	0.13	37.32	37.32	37.30
Hogs	0.23	0.24	0.24	71.52	74.64	74.60
Chicken[c]	0.24	0.25	0.25	74.64	77.75	77.75
Milk	0.03	0.03	0.03	9.33	9.33	9.33
Eggs ('000)	0.07	0.07	0.07	21.77	21.77	21.77

[a]For cattle and hogs, the quantity of net production is the live weight actually produced during the year, adjustments having been made for animals shipped in and changes in inventory.

[b]Average number of tractors used per 1,000 lbs. production x aggregate capacity of tractors engines from Table 41.

[c]Including commercial broiler production. Pounds sold replace production of chickens, beginning 1985.

Source: USDA Agricultural Statistics, various years.

the USSR. This again points to the fact that production processes in the USA are better mechanized and less human-labor consuming than in the USSR.

When the indirect energy inputs are added to the direct energy requirements, the energy input:output ratio in calories equivalent of livestock production in general can be very high in favor of the input, reaching up to 12:1 even in the USA.

The long-term trend in energy prices is generally agreed to be upward even though energy is relatively cheaper and abundant in the USSR compared to most parts of the world, nonetheless, reducing energy waste and eliminating energy-inefficient practices is necessary and makes good economic sense. Proper management and conservation techniques are known to greatly reduce the energy requirements for livestock production very rapidly.

Such efficient measures should be adapted to processes such as in the following.

Dairy operations.

Water heating, which in the case of USA, accounts for almost 16 to 18% of the purchased energy on an average dairy farm.[1]

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[1]B. A. Stout, et al., Energy Use and Management in Agriculture (North Scituate, MA: Breton Publishers, 1984), p. 99. Moreso from personal observations of the

Ventilation and supplemental heat, energy costs which can be reduced by conserving power used to ventilate or heat space. In the USSR on the average, temperatures are lower in most farm regions than in the U.S., thus more heat is needed, and consequently there is greater energy consumption.

Milk cooling, which normally requires a great proportion of total energy used in dairy operations. Even in cases where it does not take a major proportion, milk cooling deserves close attention because it uses the most expensive energy form--electricity.

Vacuum pumps, are universally used for milking on state and collective farms. In the U.S. milking accounts for 10 to 12 percent of all energy normally used on a dairy farm. If the same ratio applies in the USSR, this represents a significant amount of energy. It is also noted that, on the majority of private farms and some collective and state farms, milking is done manually.

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water heating system on some farms in the USSR, water heating for dairy operations is still done through bowl-boiling (boiling from basins) as compared to boiler-usage on observed U.S. farms, which is an indication of enormous energy wastage through this one operation alone by the use of obsolete and inefficient method.

[1]Ibid., p. 97.

In general cases, energy can be conserved, especially costly electrical energy in the grinding and feed preparation processes and brooding in poultry. It would have been more interesting to examine in detail the figures for energy use in each phase of livestock production mentioned above, but there are no readily available data to embark on such analysis.

An overall trend of energy consumption in the Soviet agricultural sector is presented in Table 44. There has been a move away from coal usage from the past to a very low level in recent times with a cutback of as much as 70% in 1987 relative to 1971 figures. Oil is still very much in demand as a source of energy for farm operation in proportion which seems to have leveled out in recent times.

Obviously, the diminishing use of coal as a source of energy is rapidly being made up for by an increase in the use of gas and electricity. Use of gas as an energy source for farm operations rose astronomically in recent times, mainly due to the abundant quantity of that energy source in the Soviet Union and the trend in usage is still upward.

Transportation Constraints to Fuel Usage on Soviet Farms

A major aspect of current Soviet energy difficulties lies in the problem of transporting energy.

Table 44. Agriculture Energy Consumption in the USSR ('000 Toe)[a] (1971-1987).

Year	Coal	Oil	Gas	Electricity	Total
1971	6,100	23,493	800	3,922	34,314
1973	6,100	27,490	1,200	4,954	39,743
1975	6,000	28,130	1,500	6,347	41,977
1977	5,400	31,352	1,700	7,602	46,055
1979	5,000	33,935	1,900	8,798	49,632
1980	4,700	35,278	2,000	9,537	51,515
1982	3,800	36,013	2,500	10,363	52,676
1983	3,300	36,641	3,000	10,888	53,828
1984	2,800	36,852	3,500	11,851	55,002
1985	2,300	37,062	4,000	12,530	55,892
1986	1,800	37,269	4,500	13,081	56,650
1987	1,880	37,476	5,000	13,502	57,858
1987 as % of 1971 (%)[b]	31	160	625	344	169

[a]On an average, .848 toe = 3,412 BTU per Kilowatt Hour

Source: USSR Government Statistics--Energy Balances, Various Years.

This is because of the USSR's large size (one-sixth of the world's land surface) and the spatial disparity between energy sources and points of demand. A key dichotomy exists between the industrialized and densely settled "European" portion of the USSR and the thinly populated, but energy rich, eastern portion (Siberia). Most of the demand for energy originates in the European portion as it contains 70 to 80 percent of the Soviet population,[1] industry, and social infrastructure.

In trying to determine the general pattern of movement for each of the main forms of energy (gas, crude petroleum, refined products, coal, and electricity) as related to Soviet Agriculture, it is necessary to identify constraints in the transportation system that inhibit efficient flows and causes enormous wastage.

Constraints

Natural Gas: Little is known about actual flows and detailed distribution to sectors. Addition of large pipelines increases efficiency and help alleviate the most serious constraints regarding wastage in the system. The question with regard to natural gas is not one of supply and demand, but the real problem of distribution.

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[1]Matthew J. Sagers and Milford B. Green, The Transportation of Soviet Energy Resources (New Jersey: Rowland and Littlefield, 1986), p. xiii.

Seasonal flow fluctuations and expansion of underground storage facilities, coupled with construction delays, also make it difficult to rationally estimate energy usage in a sector as diversified as agricultural production.

Petroleum. Except for some flows in the Caucasus and Caspian Sea, the pattern of movement in Soviet petroleum shows that little information exists on actual Soviet petroleum flow and use in agriculture.

Total transportion costs for petroleum alone accounted for are 90 percent of the actual total energy transportation costs for the USSR in 1980. First the main transport constraints in the system from source of production to use, were in the European USSR, in the older oil producing areas, rather than in the east at the origin of most of the USSR's petroleum.

Coal. The massive flows of coal from the east are of magnitudes that must be straining railroad facilities to the limit. There are expansions in Soviet railroad systems, but there continues to be a reported shortage of rail cars. Because the railroad cannot handle any additional freight, it is planned for further increments in mined coal to be consumed at large electrical power stations, with electricity being transmitted to consumers over a great distance and increased costs.

Table 45. USSR Primary Transportation of Petroleum Products in 1981.*

Mode	Shipment (%)	Average Length of Haul (MI)
Railroad	79.2	605
Pipeline	11.3	440
River Tanker	6.8	768
Seagoing Tankers	2.7	745
All Modes	100.0	600

*These data refer only to shipments within the country.

Source: Grigor'yev, Ain et al., "Optimizatisiya perevozok nefteproduktov," Zheleznodorozyniy Transport, 2 (1984), p. 61.

Electricity. The main problem in Soviet electrical network is the lack of transmission capacity, and in most cases, the rural areas of the country are neglected or undersupplied, resulting in an increased cost to agriculture when this occurs.

In general, most USSR farm energy (e.g., petroleum, natural gas) are transported by railroads. This is more energy consuming compared to use of barges that are used to transport such in the USA. The USSR

rivers flow North to South, instead of East to West, making it very difficult to transport energy by barge in the USSR.

The distances travelled by railroad from point of fossil energy production principally in the Eastern section of Soviet Union to the main farm producing regions of the West (mostly the Ukraine, Byellorussia), are very great. This results in enormous wastage during transportation and untimely deliveries that greatly delay or totally disrupt agricultural production in some cases.

Summary--Research Question 3

Linkages between the agricultural and energy sectors of the Soviet economy cannot be overemphasized. Uninhibited energy supply to Soviet agriculture operation system is paramount to the continued growth in all phases of agricultural production in the USSR. As part of the production intensification efforts now sweeping the system as a whole, there is greater need for a better management and more rigorous conservation drives in both the agriculture and energy sectors and mostly in the use of energy to further enhance agricultural production. Necessary data needed for a reasonable comparative analysis on the degree and level of efficiency in energy utilization in agriculture of both the USA and USSR are lacking, mostly due to unavailability of a quantitative

and qualitative breakdown in Soviet energy usage with regard to agriculture. The available data are aggregated into a lump under general energy usage in agriculture. Nonetheless, reasonable indicators show that the USA is ahead in adapting crucial conservation measures to better use the available energy for farm operations. The Soviet, on the other hand, in spite of abundant production resources, and potentials for self-sufficiency in energy requirement for their agricultural needs, are observed to lag behind the USA in terms of productivity and efficient use of such abundant energy resources.

There is an improvement in recent years in the procurement of necessary energy inputs to boost agricultural production in both countries. The USA is still performing better in terms of the examined input into agricultural production and relative output both in crop and livestock production. This might be as a result of the availability of superior technology and better trained personnel over the years that are better geared toward more efficient resource management. The Soviet production system is still plagued by use of crude and obsolete technologies which are neither energy efficient nor conserving. This is a principal source of the continued existence and in some cases, such as in grain production, widening of the "performance-gaps" in production figures for the USSR relative to the USA.

To conclude in response to Research Question 3, there exists some similarities and differences in the levels of energy use in agriculture in both the USSR and the USA.

The USA and USSR use a great deal of natural gas for farm production, and the use of electricity as energy source for farm operations though expensive, is on the rise in both countries. The USSR is still behind in justifying a relatively greater usage of energy per unit output in their farm production but there have been great improvements in recent times,[1] and a good reason to believe that such trend will continue into the future if the current tide of restructuring and implementation of more effective management in the USSR occurs.

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[1]USSR. Agriculture and Trade Report--Situation and Outlook Series (Washington, D.C.: USDA Publication, Report # RS-90-1, May 1990), pp. 36-38.

CHAPTER V

PROSPECTS FOR THE FUTURE

Political commentators and economic analysts in the Soviet Union often attempt to make an analogy between their current economic situation and the situation in the U.S. in the 1930's. Their focus is mainly on the occurrences of the late 1920's and 1930's, referring to it as the crisis of capitalism. According to Herbert Stein, the Soviet's claim that the U.S. responded to that crisis with the New Deal, which reformed capitalism, but did not end it.[1] Hence, the Soviet Union is seen to be going through its economic crisis, and responding with reform--with Perestroika, and it is expected that Soviet socialism will emerge from the reforms stronger than ever, but will still be socialism. In the U.S.

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[1]Herbert Stein is a political commentator for The Wall Street Journal. The title of the article is "Perestroika: Gorbachev's New Deal," December 4, 1989.

capitalism[1] in the past 60 years was not as static as some of its critics claimed it would be. It is, in fact, quite dynamic and maintains its dynamism by adapting to emerging problems. The reasons are both economic and political.

The American system, with a high degree of independence of the political and economic structures, is well suited for adaptation. The political side can easily coerce a change on the economic side without having to go through a radical transformation. And in many circumstances, the independent behavior of the economy can force a change in the political structure. Contrary to this structure, the political-economic establishment in the Soviet Union is monolithic. It is, therefore, difficult to find a clean break away from the established status quo. It is important to bear in mind that in a system where economic and political power are fused it is more difficult for the political authorities to divorce themselves from sources of discontent.

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[1]Capitalism is the economic system in which all or most of the means of production and distribution, as land, factories, railroads, etc., are privately owned and operated for profit, originally under fully competitive conditions. It has been generally characterized by a tendency toward concentration of wealth, and in its later phase, by the growth of great corporations, increased government control, etc. (Webster's Unabridged Dictionary, 1979

The preceding chapters have provided a wide-ranging survey and analysis of the past and present situation of the economies of the USSR and the USA, with regard to their agriculture and energy sectors. The current situation in the Soviet Union with regard to both delineated sectors, is one of an economy that has reached its present position by driving ahead fairly steadily, without much reported unemployment or inflation, raising output levels and living standards at quite a respectable rate. Yet the performance of the Soviet economy is not satisfactory in the eyes of the Soviets, nor is it impressive in comparison with the performance of that of the USA. Moreover, a number of basic problems have come into view as serious obstacles on the road to further progress. With this in mind, the content of this chapter will mainly focus on the situation in the USSR with selected reference to the situation in the U.S. for the purpose of suggesting measures that should be taken toward narrowing or closing the existing "performance gaps" and toward securing a more balanced economic growth and development along scientific lines. This should help to answer Research Question 4.

Factors Affecting the Future

The principle features of the Soviet economy's immediate future take their shape from the interactions

of two strong contending forces. As rightly pointed out by Hunter,

> Soviet authorities are continuing to press their steady drive for economic growth, and in the process are contending against a set of serious limitations. The limitations are partly in the resource base and partly in the economy's institutional framework. The Soviet leadership is attempting to surmount these limitations both by extending the resource base and by seeking minor institutional reforms.[1]

First and foremost, the Soviet economic statistics are of very poor quality and cannot be relied upon in most cases for adequate economic analysis or as base for planning any future alternatives. An example is the comparisons of the national income of the USSR and the USA regularly published in the Soviet statistical handbooks, which exaggerate the Soviet position, although things may be improving under Gorbachev in comparison with previous years during the Brezhnev era.

The depth of the stagnant economy of the USSR that set in after 1978 was not predictable in advance by Western "forecasters." Evidently, the reforms now going on under Gorbachev go further than many Western observers would have thought likely a few year ago.

This author observes the current moves at restructuring the Soviet economy (Perestroika) with the view of one who has lived in the Soviet system.

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[1]Holland Hunter, ed., The Future of the Soviet Economy, 1978-1985) (Boulder, CO: Westview Press, 1978), p. 167.

Therefore, this author views Perestroika as an historic development and the emancipation of a new Soviet society in which the key role is played by a modified form of the present Soviet economy. In agreement with Davidow, this author believes that Perestroika is not only, nor even primarily, the answer to the period of stagnation of the late 70's and early 80's. It is, above all, a reflection of the maturing of Soviet socialist society and its economy, of their coming of age, into the socially adult stage of socialism.[1]

According to Davidow, Perestroika is the product of 70 year of Stroika (building)--shaping, reshaping, discarding, adding and perfecting not only Soviet economy but the entire society.[2] This view is consistent with the observations of this author. Furthermore, it involved learning from the costly mistakes and misdeeds that added to the difficulty of building socialism. The people of the Soviet Union definitely built their economy in the "hard way," through struggles and wars, hence suffering through afflicted and self-inflicted wounds. All this must never be lost sight of if one is to really

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[1]Mike Davidow is an American Writer and Publicist whose comments on situations in the Soviet Union. The article in reference is "Perestroika--As I See It," Soviet Life (February 1988), p. 16.

[2]Ibid., p. 17.

understand the tremendous accomplishments that transformed the Soviet Union into the advanced country it is today.

The main factors determining what will actually happen in the near future toward making the USSR a much humanly enriched society and competitive relative to their Western counterparts such as the USA, are:

--the trends of development in the internal political situation

--the state of international relations

--the availability and accessibility to foreign credits

--efforts to attain equilibrium in the retail market

--defense costs

--the anti-alcohol campaign

--joint ventures and export promotion

--energy use and prices

--agricultural production, mainly in relation to harvest outcomes

Each of these factors standing alone constitute adequate independent study of their own in part and jointly, but the ones relevant for this particular analysis are principally the last two.

Energy and Energy Prices

In the foreseeable future, the role of energy-demand factors in the Soviet economy is going to be of very great importance. The Soviet Union may be able to meet its energy requirements internally at least for sometime, but there may be need to reduce its oil exports to the COMECON partners and some other Western economies.

The effect of oil shortage on the industries and other sectors of the economy could be reduced in ways such as reducing wasteful consumption in power stations, increasing use of natural gas, and the further development of nuclear power. This is an approach that is currently being used in the U.S. and certain Western European countries.

Coal, which is used to a much greater extent than in the West for energy production, is certainly a low quality alternative and relatively inefficient. The Soviet Union is known to have immense reserves of natural gas, but along the same line comes the problem of transporting it over the distances from Siberia without unacceptable wastage. This problem can be reduced by finding technological solutions through more joint ventures with developed Western countries.

The Soviet economy and all development efforts at the present time are very dependent on energy prices.

According to Ellman, each $1 per barrel movement in the world oil price maintained for one year is worth/costs the USSR $900 million.[1] Hence, if the energy prices around the world stabilize at their present level, or take a further downward shift, the prospects for Soviet foreign trade are bleak. The sharp deterioration of the Soviet terms of trade in the recent past is known to have been a major contribution to the disappointing economic developments over recent years.

Agricultural Production and Harvest Outcomes

This is the Soviet's number one problem. As earlier pointed out, one of the main difficulties lies in the shortage of agricultural skilled labor.[2] It has been suggested that solutions may be found in designing appropriate incentives to retain labor at the farm level.

It is generally known that meat and milk production are heavily subsidized. An increase in the subsidies must be expected and possibly even higher

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[1]Michael Ellman, The USSR in the 1990s--Struggling Out of Stagnation, Special Report No. 1152 (London: The Economist Intelligence Unit, 1989), p. 87.

[2]Barbara Severin and David Carey, The Future of Soviet Economy, ed.: Holland Hunter (Boulder, CO: Westview Press, 1928), pp. 109-111 cited the problem of a reduction in agricultural labor as a result of migration of younger and more skilled people to the cities in the period 1960-1976.

consumer prices will need to be charged for them. Annual grain imports are likely to stay at a level as high as 35 to 40 million tons to meet Soviet needs, and there will be less hard currency, usually earned by booming oil exports, to pay for them. Without making much of a belated political statement, it is difficult to see how the Soviet Union can ever match the efficiency of agricultural production in countries such as the United States and most Western countries, while at the same time, committing itself to a general economic system designed first and foremost to protect the interests of industrial workers.

More specifically with regard to agricultural production, there are severe problems of low labor productivity and increasing high costs. Quantity and quality of farm production are inadequate to meet domestic needs and hence a cause for the massive imports to which reference has already been made.

Production can be more immediately stimulated, not through large inter-farm organizations, but by encouraging small private producers. About one-quarter of total agricultural output, including one-fifth of the crops and one-third of the livestock products, comes from the private sector. Private agricultural production is derived from small land holdings, averaging less than

one-half hectare, frequently combined with one or two head of livestock and a small flock of poultry.

The long-run policy toward this sector has been constructive, but restrictions have been temporarily relaxed after bad harvests. The size of the harvest has a major impact on the Soviet economy. In 1979, the grain harvest was a quarter lower than in 1978, and marked the beginning of the stagnation period at the end of the Brezhnev era.[1] The consequently poor harvest of 1981 was a further contribution to the stagnation of 1979-82. A reversion to the poor harvests of 1979-85 would have a severely adverse effect on the Soviet economy. They would cause further market disequilibrium and a worsened balance of payments. On the other hand, if the Soviets continue to get good harvests such as that of 1986 and 1987, that will have favorable effects on the economy as a whole. The present Soviet leadership have and continue to take drastic measures which might help improve the chances of another good harvest such as that of the past recent years in the near future.

Livestock production will likely continue to increase at the more rapid post-1982 rate, but without significant changes in economic policies in agriculture,

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[1]Michael Ellman, The USSR in the 1990s--Struggling Out of Stagnation, Special Report No. 1152 (London: The Economist Intelligence Unit, 1989), p. 87.

tremendous growth potential will remain unrealized. A rapid expansion of livestock production is not expected without additional major policy changes. The continued growth in production costs will force a major increase in retail prices of livestock products by 1991.[1]

In the USA, rising costs and the possibility of energy supply interruptions such as that of the 1970s will shape the future decisions about energy use by U.S. farmer. Conservation still remains an effective means of reducing both energy requirements and per unit production costs. Alternative energy sources hold substantial promise for the future. But a number of perplexing problems will limit the use of these energy sources in the near future--high initial investment costs, low or negative energy efficiency, and limited economic feasibility. On balance alternative energy supplies are not likely to play a significant role in U.S. agriculture for some time. Conversely, over the next two decades energy conservation will be of major importance.

Plausible Forecasts and Propositions

Most likely prospect seems to be for a combination of some plausible scenarios.

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[1]Edward C. Cook, The Soviet Livestock Sector--Performance and Prospects (Washington, D.C. USDA Publication, Foreign Agric. Econ. Report #235, 1988), p. 27.

On the institutional level, unchanging or merely remodifying Soviet policies to slightly resemble past experiences in policies and struggles to deal with the objective developments, will cause more difficulties. In dealing with such difficulties, the present administration under Gorbachev would continue applying the standard remedies of the past early onset of the reform (Perestroika), in spite of their declining effectiveness. Strenuous campaigns to surmount obstacles and achieve priority targets would continue, leaving shortages and distortions in their wake, yet the rate of progress would be slower than in the past. The Soviet might grow stronger and the people consequently improve their lot, but the quality of life would be widely perceived as unsatisfactory and the international standing of the USSR would not be impressive or advance.

An interesting alternative to the above scenario would involve what is currently occurring in the Soviet Union. There would be emergence of a new set of party leaders, a group of reformers willing to make substantial changes in Soviet economic institutions. Examples of the Draconian measures that might be embarked on by these new

sets of infused leadership are the decollectivization of agriculture, making allowance for the growth of the individual and cooperative sectors, the leasing of state assets to individuals as well as cooperatives and the growth of joint ventures. According to Ellman, the large scale state sector will remain preeminent and will probably remain subject mainly to bureaucratic, rather than market forces.[1] Reform in this sector over the period considered will probably contain a large ritual element.

On the other hand, there could be another era of very low growth rate due to the failure on the part of the authorities to realize their ambitious acceleration plans. Nonetheless, some modest success, with growth in 1989-93 exceeding the very poor record of 1981-85 is possible. Important contributions could come from the reduction of the military expenditure. The relative high rate of inflation would definitely set in, resulting from a combination of official attempts to reform relative prices, the high and rising levels of the budget deficits, and the new founded freedom for state and individual enterprises.

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[1]Michael Ellman, The USSR in the 1990s--Struggling Out of Stagnation, Special Report No. 1152 (London: the Economist Intelligence Unit, 1989), p. 87.

The increase in debt (international and domestic) would arise from the decline in world energy prices, the inability of the USSR to increase exports of manufactures and conforming need to import coupled with the interest and willingness of majority or Western governments and banks (already announced by World Bank) to lend to the USSR under current circumstances. Consequently, an increase in the debt service ratio would follow from the increase of its debt at a faster rate than of its exports.

On the socioeconomic level, strikes and demonstrations over socioeconomic grievance could well continue to occur and be of some significance. The fundamental reason for this is the contrast between the extravagant promises of the authorities and the failure to realize them. Already as in many cases in parts of the Soviet Union, Boris Yeltsin, a newly elected Russian Republic party leader, in the past, candidly argued that "In 70 years we have not solved the main problems, to feed and clothe the people, provide adequate services and solve social questions."[1] Socialism and the Communist party have reigned over the country for more than seven decades in the name of "glittering future and expectations" to which it was supposedly leading the

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[1]Pravda, 4 March 1989.

USSR. Nevertheless, it has been unable by the end of this period even to provide sufficient good quality food.

On the whole, precise forecasts of the medium term development of the Soviet economy are inevitably of little value in light of the volatility of current changes and unpredictable political factors. In the present and maybe much further into the immediate future, continuing crisis would be characterized by a continuation of the stagnant economic situation which began in the late 1970s. The technological gap between the Soviet and their Western counterparts would grow and many means of production, though in the process of being replaced, would remain obsolete and environmental situation would deteriorate further. This would be closest to what has been seen so far under Gorbachev.

Agriculture would be partially decollectivised on a continuous basis, further allowing the individual and cooperative sectors to grow quickly, and hence radically changing the position of the state enterprises. The imports of manufactures would help improve the quality of like Soviet goods.

Acceleration in generally, mostly in all sectors, agriculture and energy inclusive, would see an implementation of the aim that was so much stressed in 1985-86 and consequently embodied in the five-year plan for 1986-90 and beyond. Economic growth could really

accelerate and the USSR could break decisively with the stagnation of the late Brezhnev period.

Forecasting Difficulties

In general, from past and present personal experiences, poor statistics and the importance of political events to economic developments make forecasting the Soviet economy a precarious task. For example, after a lapse of some years, publication of data on collective farm market prices and the grain harvest have just resumed.

The economic stagnation which set in after 1978 was not only unplanned, but also unexpected by Western "forecasters." Correspondingly, the reforms now being attempted by Gorbachev and the steady disintegration of the Socialist system and COMECON alliance go further than many Western observers would have thought likely a few years ago.

In all economic systems, political factors play a large part in determining outcomes. In the USSR, their role is much larger relative to that of capitalist economies such as the USA, since the state owns, controls, and directs the entire economy. Consequently, the scope for spontaneous purely economic factors is much reduced.

According to Goldman, cause and consequences of political decisions are much more poorly understood than economic ones.[1] Forecasting the Soviet economy is more difficult than forecasting capitalist economies. The autocratic elements in the Soviet political system complicates forecasting.

The reform ideas now being implemented in the USSR have been known and acknowledged to be around for a long time. The vigorous promotion owes a lot to one individual at the top. This is a indication of how centralized and "sophisticated" this gigantic economic system is. If Gorbachev were to have a problem tomorrow and be replaced by someone else, prospects for the USSR might or would most certainly be different. The fact that according to the advocates of reform, the USSR may be a major institutional turning point (already in the making), analogous to 1929-30 spread of socialism and its eminent disintegration as a chain effect, and this indeed makes normal forecasting methods, which just project the past into the future, of limited value.

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[1]Marshall I. Goldman, U.S.S.R. in Crisis: The Failure of an Economic System, 1st ed. (New York: Norton, 1983), p. 39.

Summary--Research Question 4

Some scenarios have been sketched describing future developments in the USSR into the near future. One of such scenarios which is now being witnessed is a continuation of the economic crisis which has and continues to plague Gorbachev. Continuing along the same line, the positive and negative sides of the push toward reform was discussed and consequently the policy of accelerated production levels.

These various factors affecting the future as pointed out are very crucial to the success of the continued growth and development of all facets of the Soviet economy, the energy and agriculture sector inclusive. It is a plausible, but very likely, suggestion that the next few years will be characterized by stagnation or low growth and further political and economic disequilibrium combined with significant but peripheral reforms and widespread popular discontent.

Nonetheless, there is work to be done and a lot to be strived for toward forging along a renewed growth path for the Soviet economy. The task is not an impossible one, but, by all standards, more efforts need to be made toward closing the existing "performance gaps," with other developed countries and "economic powers" of the world such as the USA. Taking these steps will also be a help toward securing a more balanced

economic development along scientific lines and relaxing of the bureaucracy in the USSR to generate a better performance in the near future, in answer to Research Question 4.

CHAPTER VI

GENERAL SUMMARY AND CONCLUSION WITH SUGGESTED FUTURE RESEARCH NEEDS

General Summary and Conclusions

This study set out to survey the present and past situation of the agriculture and energy sectors of the economies of the USSR and the USA, spanning the time mostly between 1960 and the current period, with a view to understanding the linkages between these two fundamental, but important, sectors in both economies. The concern was primarily to look into the development process as related to the agricultural and energy resources,and within this process, to focus on the linkages in the development and use of some selective energy resources in the agriculture of the USSR and the USA.

The specific objectives of the study were:

1. To identify the differences in the level of development and use of selective agricultural and energy resources of the USSR and the USA with specific on period spanning the 1960's until present time.

2. To identify the trends in growth rates and national disparities in their various planning periods

with regard to development and use of these selective agricultural and energy resources.

3. To identify the major problems of the two countries as related to the development and use of the selective agricultural and energy resources, and the linkages that might be identified in relating the role of energy use to agricultural development.

4. To suggest measures for improving an existing strategies for securing an improvement on current situations in both countries that might generate a better performance.

The following research questions were developed to add specificity to the answers determined by the objectives stated above:

1. Does there exist objective indications that show significant disparities in the level of development in both the agricultural and energy sectors of the economies of the USSR and the USA?

2. How have these inter-country disparities grown over the years and various planning periods?

3. What (if any) are the existing similarities and differences in the levels of energy use in agriculture in both the USSR and the USA?

4. What measures can or should be taken for closing the existing "performance gaps" toward securing balanced economic development along scientific lines and

relaxing of the bureaucracy in the USSR to generate a better performance in the near future?

This study has found that objective indicators do show significant disparities in the level of development in both the agricultural and energy sectors of the economies of the USSR and the USA. There has and continues to be significant structural differences in the agricultural and energy sectors of both economies at different stages of their development.

Over the years, agriculture has relinquished its significant role in the economy of the United States both in terms of labor employment where in the 1920's more than 30 percent were engaged in agricultural production compared to 3 to 4 percent in the present-day farm population. On the other hand, agriculture continues to play a significant role in the Soviet economy. It currently employs more than 20 percent of the total population which does not show much change dating back from the structure of the economy in the 1920s. The energy sector, on the other hand, show that there is a larger growth in energy production and use in the USSR relative to the USA significantly since the 1970's, an indication that possibly could be a response to the size difference of the countries.

Evidences in this study, show that over the span of various planning and development periods, especially

in the emphasized recent decades, from the 1960s to 1980s, there occurred numerous changes in the performances of both sectors (agriculture and energy) in the economies of the USSR and the USA and a great widening of these differences over time. The Soviet agricultural production, most especially grain production, has grown rather slowly, and has become a source of "leakage" in the entire economy.

In the USSR, progress has been made and more energy resources brought into use in very large quantities surpassing the lead that the USA had in this sector in the past. Varied indicators show that the USSR is still far from maximizing its potential in improving agriculture and energy productivity to surpass or be at par with the USA. There remains a great reliance on oil and natural gas almost exclusively as the means to satisfy the growing energy demand in the Soviet Union. General results of the state of explored fuel and selective energy resources indicated that there has been a great expansion in the use of these resources, especially natural gas in the USSR relative to the USA. Soviet research and development efforts are marred by poor decision-making processes, perverse personnel policies, disastrous information policies, which are some of other major reasons why they lag behind the USA and some industrial Western countries and also a reason for

the widening of the "performance gap" between the Soviet economy and that of their Western counterparts.

It was determined that uninhibited energy supply to a wasteful Soviet agriculture operation system has to be curtailed if productivity is to be increased. Necessary data needed for a reasonable comparative analysis on the degree and level of efficiency in energy utilization in the agriculture of both the USA and USSR are lacking, mostly due to unavailability of a quantitative and qualitative breakdown of Soviet energy usage with regard to agriculture. Nonetheless, reasonable indicators, such as better management techniques and machinery among others, show that the USA is ahead in adapting crucial conservation measures to better use the available energy for farm operations.

There has been an improvement in recent years to boost agricultural production in both countries. The USA is ahead in adapting modern and useful technology and better trained personnel geared toward more efficient resource management. The Soviet production system is still plagued by use of obsolete technologies which are neither energy efficient nor conserving. This is a principal source of the continued existence and in some cases, such as in grain production, widening of the "performance gaps," in production figures for the USSR relative to the USA. The USA and the USSR use a great

deal of natural gas for farm production, and the use of electricity as energy source for farm operations though expensive, is on the rise in both countries.

This study employed the historical, descriptive, and empirical method of research whenever possible. The main dilemma in embarking on this type of sectorial analysis of a system and consequently comparing two alternative structure to judge performances, is one's ability to reasonably answer such a key question as: Can the specific factors that influence energy use in, say, agriculture in the United States (or the Soviet Union) be sufficiently isolated so that comparisons between the two sets of factors can be made? This author encountered serious difficulty in trying to do so. Since there are several factors contributing to an economy's performance, it is difficult to tell what the separate contributions of these factors are.

Deductively, but not conclusively, from presented evidences in this study, it can be said that the USSR and the USA have their similarities and enormous differences. Much as the Soviet Union stand out in an enclave of its own, the USA has an advantage in the past and present in the matter of agriculture. The same could have been said for the Soviet Union as far as the case of energy goes, but because of the enormous wastefulness (some due to carelessness and some of them bestowed on them by

nature), there is still a doubt with regard to the continuity of this advantage.

There are things to be done and that should be further looked into toward shedding more light on the issue of the agriculture and energy resources of both countries, and the respective interlinkages in particular.

The comments contained in this dissertation should not be interpreted as offering the "complete picture" or "answer" to the individual shortcomings or pitfalls with regard to the development and use of the selected analyzed resources of either economy, but rather the author seeking to present fundamental evidence and basic facts to help sharpen the understanding of some important empirical questions regarding the topic in discussion.

Future Research Needs

There is a need for further in-depth research that could help us better understand and broaden our knowledge of the topic of this discussion and some other related or not too distant questions. The American system, though not without its own flaws, have been shown to be fairly tolerant to changes and signals for improvement. In short, in comparison to the Soviet system, it works better.

Soviet-type systems of centrally administered allocation though important because of their weight today in terms of geography, population, and share in world production and pedagogic value, they have helped deepen our understanding of the intricacies of other models, those that they lived under, as well as issues involved. The system has proven in recent times to have a very short life span. There is a need for change and hence the answer might well be the current winds of reform blowing across the land, which is supposed to help ameliorate the economic shortfalls. A major objective of the current economic reform is to create new institutions and new environments in all phases of Soviet life, which will stimulate technical progress toward quality and quantity.

Some priority areas for future research that one would have liked to have seen addressed in detail are:

--Use of energy in the various sectors of Soviet economy and production systems. There is a need for a regional analysis of such energy uses so as to shed more light on the issue of technical efficiency. There is currently very limited data available to embark on any kind of reasonable analysis in this direction.

--The Soviet data on the stock of machinery should be analyzed for a better understanding of machinery--turnover and their efficiency ratios (input/

output analysis). This will help to shed light on the issue of technology modernization, adaptability and appropriateness--toward making a definite statement about the overall efficiency of the Soviet capital stock.

There is need for a close scrutiny into the current efforts at making changes. This calls for a better understanding of where the Soviets have been, where they are, and where they want to be. Hence, the need to address key economic issues, such as distribution of labor, production, efficiency, commodity prices, wages and profit, in detail. For example, what can and should be done about the redundancy of labor in Soviet agriculture.

There is need for a better access to information through data generation and availability, to guarantee a better understanding of the system. Hopefully, with "Glasnost" and "Perestroika," more information would become available and will eventually open up more inroads to a better understanding of strengths and weaknesses of alternative economic systems.

APPENDICES

APPENDIX A

FACTS AND FIGURES--APPENDIX TO CHAPTER II

APPENDIX A

FACTS AND FIGURES--APPENDIX TO CHAPTER II

USSR

Location: Eastern Europe and Northern Asia. Occupies the main northern continental mass of Europe/Asia, with coastlines on the Black Sea to the southwest, Baltic Sea to the northwest, Arctic Ocean to the north, and Sea of Okhotsk, Bering Sea and Sea of Japan to the east; Norway, Finland, Poland, Czechoslovakia and Hungary are to the west, Romania to the southwest and Turkey, Iran, Afghanistan, China, and Mongolia to the south; there is a short border with North Korea in the east and Alaska (United States) is to the east across the Bering Strait, and Japan to the southeast across the Sea of Japan.

Land

Area: 22,402,200 km^2 = 8,649,500 mi^2

Usages (1984): Agricultural 6,054/50 km^2 (27%) of which

Arable 2,277,000 km^2 (10%); cropland 45,150 km^2 (0.2%)

Pastures 3,732,000 km^2 (17%), forest 9,320,000 km (42%)

Climate: Continental, arctic in the north
Weather in Moscow, 156 m altitude:
Temperature: Hottest month July 12-23 C
Coldest Jan. minus 16-minus 9C
Rainfall (av. monthly): driest month March 36 mm, wettest July 88 mm

People: Population: 1970 242.77 mm
1980 265.54 mm
1985 278.62 mm

Growth: 1970-80 0.9% p.a.;
1980-85 1.0% p.a.

Density (1985): 12 people per km^2

Resources

Livestock (000, 1-1-85)	Cattle	121,055
	Buffalo	320
	Sheep	142,876
	Pigs	77,914
	Goats	6,325
	Horses	5,750
	Camel	250
	Poultry	1,143,000
Mineral Reserves (1981)	Coal	108,800 mn tonnes
	Lignite	131,500 mn tonnes
	Crude Oil	12,158 mn tonnes
	Natural Gas	30,700 bn cubic meters
(1976)	Uranium	160,000 tonnes

Petroleum Refinery Capacity (1984) 600 mn tonnes

Electrical capacity (1984) 304,000 megawatts of which
Hydro 59,300 megawatts
Nuclear 24,100 megawatts

Summary

Political: Communist republic, formed as such in 1917; comprises a union of 15 republics, member of UN, Comecon and Warsaw Pact. Two of the republics, Byelorussian SSR and Ukrainian SSR have separate membership in the UN.

Economic: An industrial economy, with major agricultural and mining sections, crude oil and product are the largest export, accounting for about two-fifths of total exports, and machinery accounts for about one-tenth of exports.

Natural gas, transport equipment, iron and steel, timber and coal are also major exports.

Accounts for about three-quarters of Warsaw Pact countries in terms of population and gross domestic product, but more than 90 percent of defense expenditure.

USA

Location: North America and Pacific Ocean Continental United States has Canada on the northern boundary and Mexico on the southern. Alaska is bounded to the southeast by Canada and to the west by the Soviet Union. Hawaii is in the Central Pacific 3,900 km (2,400 miles) to the west of the mainland.

Land: Area 9,372,570 km^2 = 3,618,700 mi^2

Usage (1982): Agricultural 4,313,820 km^2 (46%) of which

Arable 1,878,810 km^2 (20%),

Cropland 20,340 km^2 (0.2%)

Pastures 2,414,670 (km^2) (26%)

Forests 2,651,880 km^2 (28%) other

Climate: Mainly temperate; sub-tropical in the south.
Weather at Washington, D.C.
22 m altitude:
Temperature: Hottest month July 21--31C
Coldest January minus 1-7 C.
Rainfall: (av. monthly) driest month
February 68 mm, wettest August 120 mm.

People: Population 1970: 205.05 mn
1980: 227.76 mn
1985: 239.28 mn

Growth: 1970-80: 1.1% pia
1980-85: 1.0% p.a.

Density: 1985: 26 people per km^2

Resources

Livestock	(000,Jan 1985)	Cattle	109,749
		Pigs	54,073
		Sheep	10,443
		Goats	1,550
		Horses	10,580
		Chicken	1,050,000
		Turkeys	53,000

Mineral Resources	Coal (1979)	125 bn tonnes
	Lignite (1981)	3.97 bn tonnes
	Crude Oil (1981)	3.97 bn tonnes
	Natural Gas (1981)	5,712 bn cu meters
	Uranium (1984)	398,100 tonnes

Petroleum Refinery Capacity (1984) 771 mn tonnes

Electrical Capacity (1984)	688,430	megawatts of which
Hydro	82,102	megawats
Nuclear	71,861	megawats
Geothermal	1,370	megawatts

Summary

Political: Republic, which became independent from Great Britain in 1776. There were 13 original states; the number now is 50; the most recent admissions were Alaska in 1959 and Hawaii in 1960.

Member of UN, OAS, OECD, NATO, Colombo Plan, and South Pacific Commission.

Economic: The widespread nature of the economy is indicated by a broad range of exports including machinery, chemicals, motor vehicles, and aircraft, as well as cereals; manufacturing provides about one-fifth of gross domestic product (GDP), and absorbs about the same proportion of the labor force. The business cycle is relatively autonomous in the United States, since exports account for only 7% of GDP, the economy is relatively self-sufficient. Imports were much higher than exports in the first half of the 1980s; the deficit for trade in goods went above $100 bn in 1984.

APPENDIX B

STATISTICAL APPENDIX TO CHAPTER IV

Table B-1. Acreage Irrigated with On-Farm Pumped Water (Thousand Acres)

Region	1974	1977	1980	1983	1974	1977	1980	1983	1974	1977	1980	1983
	Electricity				Diesel				Gasoline			
Northeast	31	30	25	35	68	101	107	147	177	160	135	135
Lake States	295	452	595	705	81	237	424	432	23	49	106	114
Corn Belt	72	155	286	315	75	256	429	460	114	95	59	54
Northern Plains	1,572	2,612	3,274	3,594	1,544	2,915	2,793	2,846	151	72	79	81
Appalachia	104	18	30	23	22	87	139	182	62	114	113	128
Southeast	587	582	963	1,120	1,045	1,613	1,968	2,319	189	240	211	197
Delta States	504	781	1,571	2,019	645	1,102	1,197	1,499	591	310	93	28
Southern Plains	2,007	2,139	2,054	1,957	151	156	165	159	108	105	103	94
Mountain	4,296	4,619	4,789	4,872	308	350	333	380	86	75	138	63
Pacific	6,197	6,717	6,745	7,118	4	9	134	130	0	0	0	0
Alaska	3	2	2	2	*	-	-	-	1	*	*	-
Hawaii	72	85	85	85	-	-	-	-	1	-	-	-
TOTAL	15,743	18,192	20,419	21,845	3,943	6,826	7,689	8,554	1,503	1,220	1,035	894

	Natural Gas				LP Gas				Total			
Northeast	-	-	41	-	18	13	13	13	294	304	319	330
Lake States	-	-	-	-	11	12	29	18	410	750	1,154	1,269
Corn Belt	1	25	6	5	100	103	146	155	362	634	926	989
Northern Plains	2,430	3,231	3,593	3,638	1,552	1,008	1,291	1,433	7,249	9,838	11,030	11,592
Appalachia	*	2	2	3	3	1	6	7	191	222	290	343
Southeast	*	2	2	2	222	273	336	222	2,043	2,710	3,480	3,860
Delta States	205	182	117	110	744	287	58	104	2,689	2,662	3,036	3,760
Southern Plains	6,742	6,341	6,204	5,837	508	529	493	474	9,516	9,270	9,019	8,521
Mountain	1,156	1,100	1,089	1,075	184	138	198	183	6,030	6,282	6,964	6,573
Pacific	85	31	85	85	-	-	-	-	6,286	6,757	6,964	7,333
Alaska	-	-	-	-	-	-	-	-	4	2	2	2
Hawaii	-	-	-	-	-	-	-	-	73	85	85	85
TOTAL	10,619	10,914	11,139	10,755	3,342	2,364	2,570	2,609	35,147	39,516	42,852	44,657

Note: - = none reported; * less than 1,000 acres

Source: Agricultrual Statistics (USDA), various years/Hosteller & Sloggett, 1984.

Table B-2. Total Energy Expenditures and Annual Percentage Change for On-Farm Pumped Irrigation Water

Region	1983 Total Dollars	Annual Change		1983 Total Dollars	Annual Change		1983 Total Dollars	Annual Change	
		74-80	80-83		74-80	80-83		74-80	80-83
	Million	Percent		Million	Percent		Million	Percent	
	Electricity			Diesel			Gasoline		
Northeast	0.9	50.0	41.7	6.4	56.3	27.6	5.3	7.3	5.1
Lake States	26.9	106.7	15.1	27.0	292.4	10.8	7.4	166.7	4.0
Corn Belt	6.7	358.3	16.3	14.2	408.3	13.1	3.1	12.5	3.6
Northern Plains	131.5	62.1	15.8	185.4	75.0	1.0	8.6	19.5	4.4
Appalachia	0.4	4.2	-6.7	7.9	733.3	25.2	6.1	100.0	8.2
Southeast	42.1	135.9	14.6	150.1	219.1	17.2	17.4	82.8	-4.8
Delta States	57.8	173.1	31.8	60.7	93.2	18.7	1.3	-6.9	-23.5
Southern Plaines	87.7	21.3	12.6	11.1	44.1	-3.5	9.3	28.8	-4.9
Mountains	364.8	29.4	5.0	45.3	37.6	-0.2	9.8	4.8	5.1
Pacific	320.4	37.5	6.1	14.2	283.3	-3.7	-	-	-
Alaska and Hawaii	52.0	29.9	-	-	-	-	-	-	-
TOTAL	1,151.2	36.9	8.1	523.3	93.1	7.1	68.3	20.7	-1.1
	Natural Gas			LP Gas			Total		
Northeast	-	-	-	0.4	5.6	-	13.0	20.2	12.3
Lake States	-	-	-	1.1	200.0	-5.1	62.4	164.7	11.1
Corn Belt	*	*	*	3.4	25.9	15.9	27.4	89.8	12.8
Northern Plains	150.3	68.8	17.6	102.6	20.0	13.5	578.4	52.8	9.7
Appalachia	*	*	*	0.4	*	33.3	14.8	123.6	15.5
Southeast	*	*	*	18.1	76.5	-5.7	222.7	145.6	11.2
Delta States	2.9	60.0	8.7	4.8	-12.8	55.6	127.5	36.2	21.9
Southern Plains	229.4	39.0	10.3	47.8	23.6	12.5	385.3	31.8	9.9
Mountains	157.6	40.5	29.2	17.1	28.7	-0.6	594.6	30.8	8.6
Pacific	9.7	154.8	11.6	-	-	-	405.3	41.1	5.7
Alaska and Hawaii	-	-	-	-	-	-	52.0	29.0	-
TOTAL	549.9	46.3	16.5	195.7	21.4	9.3	2,488.4	42.5	9.2

Note: - = none reported; * = less than 1,000 acres.

Source: Agricultural Statistics (USDA) various years/Hosteller & Sloggett, 1984.

Table B-3. Mineral Fertilizer Delivered to Agriculture from 1964 to 1980 (in thousands of tons)

	1964	1968	1970	1972	1974	1976	1978	1980
Standard weight	21,961	36,101	45,649	54,795	65,884	77,732		
			(45,379)[1]	(53,932)	(63,841)	(75,010)	(79,002)	(81,993)
Nitrogen	8,584	16,847	22,463	27,436	32,908	35,758		
				(27,346)	(32,665)	(35,376)	(37,358)	(40,301)
Phosphate	6,865	9,351	11,821	14,741	19,320	24,091		
			(11,551)	(13,968)	(17,520)	(21,751)	(24,334)	(25,456)
Rockphosphate	2,972	4,662	5,122	4,756	4,650	4,395		
							(4,258)	(4,369)
Potash	3,416	5,231	6,187	7,784	8,914	13,407		
							(12,967)	(11,788)
Nutrient weight	5,040	8,273	10,368	12,530	14,958	18,255		
			(10,317)	(12,367)	(14,572)	(17,739)	(18,420)	(18,763)
Nitrogen	1,759	3,454	4,605	5,624	6,746	7,330		
				(5,606)	(6,696)	(7,252)	(7,658)	(8,262)
Phosphate	1,284	1,748	2,211	2,757	3,612	4,506		
			(2,160)	(2,612)	(3,276)	(4,068)	(4,551)	(4,760)
Rockphosphate	565	886	973	904	884	835		
							(809)	(830)
Potash	1,421	2,176	2,574	3,238	3,708	5,557		
							(5,394)	(4,904)

[1]Figures in parentheses are revised numbers which exclude feed additives. From 1978 onward, Narkhoz only reports figures which exclude feed additives.

Source: 1964 figures from Narkhoz (1964), p. 338; 1968 figure from Narkhoz (1969), p. 354; 1970 figures from Narkhoz (1970), p. 339; 1972 figures from Narkhoz (1973), p. 421; 1974 figures from Narkhoz (1975), p. 383; 1976 figures from Narkhoz (1977), p. 245; revised figures excluding feed additives 1972 and 1974 (1975), p. 383; revised figures for 1976 from Narkhoz (1977), p. 245; reivsed figures for 1978 from Narkhoz (1978), p. 235; revised figures for 1980 from Narkhoz (1980), p. 237.

Table B-4. Fertilizer Applied per Hectare of Sown Land from 1964 to 1980 (in kilograms)

	1964	1968	1970	1972	1974	1976	1978	1980
Standard weight	99.3	164.2	207.1 (205.9)[1]	243.9	287.1	336.6	353.6	366.5
Nitrogen	38.8	76.5	101.9	123.6	146.9	158.8	167.2	180.1
Phosphate	31.1	42.4	53.6 (52.4)	63.2	78.8	97.6	108.9	113.8
Rockphosphate	13.4	21.2	23.2	21.5	20.9	19.7	19.1	19.5
Potash	15.4	23.7	28.1	35.2	40.1	60.2	58.0	52.7
Nutrient weight	22.8	37.5	47.0 (46.8)	55.9	65.5	79.6	82.5	83.9
Nitrogen	8.0	15.7	20.9	25.4	30.1	32.5	34.3	36.9
Phosphate	5.8	8.0	10.0 (9.8)	11.8	14.7	18.3	20.4	21.3
Rockphosphate	2.6	4.0	4.4	4.1	4.0	3.8	3.6	3.7
Potash	6.4	9.8	11.7	14.6	16.7	25.5	24.2	21.9

[1]Figures in parentheses are revised as of 1975 Narkhoz.

Source: 1964 figures from Narkhoz (1964), p. 341; 1968 figures from Narkhoz (1969), p. 357; 1970 figures from Narkhoz (1970), p. 342; 1972 figures from Narkhoz (1973), p. 423; 1974 figures from Narkhoz (1975), p. 385; 1976 figures from Narkhoz (1977), p. 247; 1978 figures from Narkhoz (1978), p. 236; 1980 figures from Narkhoz (1980), p. 238.

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