Future Prospects of Animal Production of Fats and Protein[1]

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ABSTRACT

Present trends in the global animal production of fats and protein are reviewed. The dominance of the West and the temperate latitudes is underlined, and the uniqueness of China and Japan are analyzed. The global disparities are based primarily on the ample soil resources in the West allowing for extensive production of feed crops, led by oilseeds. A second major input is fish protein, half the catches of fish from the oceans being converted into meal and oil. This kind of secondary or even tertiary production is unlikely to be copied under the parsimonious conditions of the poor world. The relative roles of oilseed and fish proteins are analyzed. Future trends are discussed on the basis of the FAO projections presented in the Indicative World Plan.

Within the brief time alloted to projecting the future prospects of animal fats and protein, I have chosen to analyze a few selected factors that in my estimation are frequently neglected or overlooked entirely. The analysis is based on my 20-30 years of study in this general area of protein and fat utilization, with particular reference to world feeding. As a consequence, I will allude only briefly to issues that are currently elaborated in programs concerning our immediate food future, but that in all likelihood will be less influential in the long run than is generally assumed.

I will begin with a brief review of present trends in animal production of protein. The affluent West, largely in the temperate zone, dominates the production of milk, meat of all categories, and of eggs (Table I). Add to this China, high-ranking in the production of hogs, poultry and eggs, but with 820 million consumers (Table II). Japan has surged to the fourth position in eggs, but this is based almost entirely on fish meal and feed purchases from the West. Only around one-fifth of the global animal production falls in the warm latitudes, embracing more than half the world's peoples.

The raising of hogs in China is unique in many regards, being mainly a subsistence operation; but more importantly it is in little competition with man for primary production. In China, hogs are traditionally scavengers, and their resurgence is within this general framework. These are also the basic conditions under which egg-layers are raised, providing eggs and meat. China has come to rank second in the world in both these commodities (Table II).

This brings us to a second feature, namely the very intimate relationship between oilseed crops and the raising of animal protein. Persistently increasing percentages of all meat, milk and eggs are based on feed concentrates, originating with soybeans, cottonseed, peanuts, etc. U.S. soybeans have in effect become the key basis for the meat production of the U.S., as well as that of Western Europe, Canada and Japan.

PRODUCTION FEATURES

Milk production has by and large remained a feature of the Western temperate world (Table I). Only in a few restricted areas with a lengthy nomadic tradition (Mongolia, Mauritania, Somalia, etc.) does milk have any significance. This is closely connected with the lactose intolerance, where presumably also genetically determined factors play a role. This feature is characteristic to many peoples in the warm world: Asians, Africans and American Indians.

Increasingly, beef production has been following pork and has come to be based on feed crops (alfalfa, silage, feed grain), thereby depending less on grazing pastures and rangelands, best evidenced in the feed-lot upsurge. This development has considerably widened the gap to developing countries. Both hog and poultry raising has become a highly efficient feeding operation based on feed mixtures, supplemented by amino acids, vitamins and minerals. Beef production is evidently heading the same way.

GLOBAL OILSEED TRENDS

The postwar development of oilseeds has been dramatic, with greatly expanded production in soybeans and peanuts. More significant to our analysis is the fact that temperate regions have emerged as important new sources of sunflower seeds, chiefly in the USSR and Eastern Europe, and rape and mustard seed in Canada and France. This will be important to future world trade and presumably facilitate the freeing of oilseeds as a source of human food to the Hungry World (HW), encompassing Latin America (excluding Argentina and Uruguay), Africa and Asia (excluding Japan).

Direct human comsumption of oilseed protein has expanded only marginally in the global household, despite innumerable conferences elaborating the unquestionable merits of: (1) these proteins; (2) their impressive potential; and (3) the beachheads that man, for centuries or even millennia, has established via oriental civilizations in this realm. Yet overwhelming economic factors have almost

[1]One of 11 papers presented in the symposium "The World Supply of Edible Oils and Proteins," AOCS Meeting, Atlantic City, October 1971.

TABLE I

Percentage of Global Production

	1968-69 Average		
Per cent	Milk[a]	Meat	Eggs[b]
Europe	40.1	26.8	27.4
North America	16.8	25.0	21.8
USSR	22.3	9.7	10.5
Australia and New Zealand	3.9	3.2	1.2
Total	83.1	64.7	71.6
China	0.8	14	16.2

[a]India and Pakistan 9.7 (half of which is buffalo milk).
[b]Japan accounts for 8.4%.

TABLE II

1968-70 Ranking of China in Animal Production

Country	Pork, %	Country	Eggs, %	Country	Poultry, meat, %
1. China	25.1	U.S.	20.1	U.S.	40.7
2. USA	17.2	China	16.2	China	18.5
3. West Germany	10.2	USSR	10.5	USSR	5.8
4. USSR	9.8	Japan	7.9	France	4.0
Total, million metric tons	33.2		20.2		13.8

TABLE III

1967-68 Production and Utilization of Protein (Oilseeds and Animal Products), Million Metric Tons

Oilseed proteins	Production	Direct human food (approx.)	Meat	Production	Consumption
Soybeans	16.0	4.0	Beef, veal	5.6	5.1
Peanuts	4.5	1.5	Pork	5.1	4.6
Cottonseed, 30%	6.0	2.0	Mutton	1.0	0.9
Rapeseed, 35%	1.9	---	Poultry	1.8	1.6
Sesame seed, 25%	4.2	2.5	Miscellaneous	1.5	1.3
Sunflower seed, 20%	2.0	1.0	Milk	12.5	8.6
Coconuts, 3.8%	1.1	1.0	Eggs	1.0	0.9
Copra, 7.5%	2.4	---			
	38.0	12.0			

predetermined the channels of utilization. In effect, few serious efforts have been made to change these patterns. On the contrary, a firmly expanding percentage of soybeans, peanuts, cottonseed, etc., has become, almost behind the scene, the backbone of animal production in the Western World. Early dependence on leguminous pastures has moved into the shadow of this massive deployment of oilseed proteins. This fact of history is greatly overlooked in the present protein debate. It was only through clover, alfalfa and pulses that Western man attained a dependable return flow from the prairies, the pampas and the grasslands of Oceania. The next phase was this huge input of oilseed protein.

The flourishing of the Western feed industry, reflecting economic advantages, has not been the only element in this turn of events. A greater driving force has been the efforts to provide cheaper food fats. In writing and thinking, oilseed crops have been regarded primarily as a source of fat (margarine, shortenings). This is mirrored in the lingering habit of listing even seeds in terms of oil equivalents. Absurdly enough, there was even a time when oilcakes, meal and other residues were looked upon as cumbersome byproducts, and only gradually were they ever upgraded to feed.

In a world moving toward a more equitable food distribution, oilseeds share with pulses considerable potential as alternatives to animal protein. Such a switch will take place, presumably not in current terms, but when food technology is mobilized to create and flavor these proteins to simulate animal counterparts, and this is in lieu of streamlining a modern production of the more than 100 attractive products devised by earlier civilizations. Milk and meat analogs will in all likelihood remain a luxury phenomenon with limited viability, mainly on the extravagant western scene. Imitation milks led to an upsurge of the world market of casein, but flowing chiefly from New Zealand to the U.S.

Recognizing different conversion efficiencies, it is undeniable that the large crops of oilseed proteins now channeled into animal production represent a potentially more significant input to human nutrient supplies than do the cereals.

Oilseed proteins dominate the scene of animal feed (Tables III and IV), in volume and still more through their nutritional potency, mirrored in their higher protein content and their superior quality. Notable is the contrast to pulses and nuts which, in relative terms within each category, play a far greater role in direct human feeding (Table III). Yet the oilseeds in absolute quantities hold the top position, primarily due to the high intake of soybean products in China, Japan, Korea, etc. The oilseed protein potential is therefore considerable, as almost 70% moves into feed. Most of this would, under a more equitable global allocation, be channeled into direct human food, with or without fermentation.

Both petroprotein and amino acid supplementation to cereals are far less attractive both logistically and economically. Bluegreen algae may have a competitive potentiality, but to date is only recognized by select groups such as the early Aztecs, the Chinese or African tribes around Lake Chad. A French pilot plant is testing this alternative with *Simulina* species.

This disposition of oilseeds is largely explained by two factors: (1) their technical history; and (2) the greater land resources of Western man. Man could, as a consequence, allow himself the contradictory frivolity of undermining his health by massive injections of empty calories of sugar and fats, but compensates for this by a mounting consumption of meat, milk and eggs (not yet afforded by all). These are the two major features in nutritional changes in the last 100 years in all Western countries.

The U.S., however, shares with the USSR the distinction of having more land (tilled land and pastures) to feed each citizen than most countries of the globe. The prairie (1850-1950) became the outlet for millions of people from Europe, but has nonetheless remained the chief provider of Europe and, in postwar years, of Japan. Despite special programs, grain deliveries to needy countries are less significant. Besides bread grain, millions of tons of protein are transferred via feedgrains and soybean into animal production both in North America and Europe.

This is merely a statement of fact important to our analysis in two regards. No hungry, poor countries could copy this prodigality, but furthermore, due to lingering outmoded trade models, they are in turn compelled to supplement this extravagance from their own meager resources. More than nine-tenths of the oilseed cakes and meals moving into the world market end up in Europe. India has reduced its prewar deliveries of peanuts to England, but regained her standing as the top ranking seller of peanut cake and meal, now with a few more European buyers besides the United Kingdom.

As hinted earlier, U.S. soybeans constitute an integral part of European and Canadian milk production, as well as providing fat to European margarine manufacturing. Europe, together with Japan and Canada, receives nine-

TABLE IV

Annual Average Global Oilseed Production, Million Metric Tons

Commodity	1948-52	1961-65	1969-70	Gain since 1948-52
Soybeans	15.95	32.47	45.80	29.85
U.S.	7.31	19.56	30.78	27.47
Cottonseed	13.94	19.97	21.72	7.78
Peanuts	9.64	15.39	17.39	7.75
India	3.20	5.10	5.77	2.57
China	2.06	1.97	2.35	0.29
U.S.	0.84	0.89	1.26	0.42
Sunflower seed	3.89	7.36	9.76	5.87
Rapeseed	2.82	4.29	5.75	2.93
Olives	4.62	6.72	6.84	2.22
Palm kernels	8.89	10.50	9.99	1.10
Sesame seed	17.77	16.16	18.59	0.82

TABLE V

1967-68 Global Utilization of Seed Protein, Million Metric Tons

Commodity	Cereals	Corn	Rice	Wheat	Oilseeds	Pulses	Nuts
Food	51	10	17	24	9	9	2
Feed	68	15	1	8	27	1	0.5
Total	118	25	18	32	36	10	2.5

TABLE VI

Europe 1968-69: Protein Balance between Animal Production and Feed Importation

Production	Million metric tons	Net import	Million metric tons	Sum
Meat (red)	3.10	Bran	0.22	
Milk (cow's)	4.68	Soybeans	1.95	
Poultry (meat)	0.55	Peanuts	0.30	
Eggs	0.35	Oilseed cake and meal	2.91	
		Corn[a]	1.07	6.54
Total	8.68	Barley	0.09	6.54
		Fish Meal		1.17
		Total		7.71

[a]In addition some wheat is used as feed.

tenths of U.S. soybean deliveries to the world market. Less than 2% reaches what might be termed "hungry countries," Taiwan and Israel largely being the recipients of the remainder.

Many more examples could be cited to convey my third point: As world economy becomes more international, these invaluable protein sources can no longer remain parts of an outmoded power structure to boost further the Western affluence. The endless conferences on how to utilize the protein resources of the oilseeds to feed the hungry and how to narrow the hunger gap have by and large evaded these crucial issues of world economics. There are many attractive technical alternatives for soybeans in China and Japan, and peanuts in Indonesia and tropical Africa. Most procedures have been greatly improved, but their implementations have come up against the fact that the feed markets of the West can be labeled almost insatiable and can always outpay the poor and hungry billions.

As is often implied in aid programs, it is equally unlikely that these protein treasures will, at scientific symposia and in traditional planning, simply be switched to similar animal raising operations in their lands of origin. The pritein crisis, as well as the population crisis, has already attained such dimensions that almost every ounce will need to be channeled directly into human food, either as protein extenders to flour, etc., or into various formulations of human food. None of these poor countries could allow themselves the conversion losses ensuing from our kind of animal production. Animals will presumably have a place in only two instances: (1) as a means of utilizing pasturelands which are not feasible to plow due to climatic or other reasons; or (2) in the cycling of waste. This latter calls for upgrading materials, that either cannot be used directly as human food or otherwise would be accumulating.

WORLD TRADE

So far this analysis has been restricted to the agricultural scene. Yet the picture in that regard needs to be supplemented by a reminder that on top of an almost monopolistic producing machinery comes a world trade in animal products still more structured to provide almost unilaterally for the well-fed. Very little (less than 5%) reaches hungry or poor nations, the rationale being they cannot afford to buy. Few efforts have, however, been made to design any alternative models for a restructuring of this flow. This is beginning slowly within the Pacific sphere, as New Zealand and Australia have begun exploring Asian markets, not only those of Japan and Hong Kong. Such a budding trade item is Australian biscuits fortified by milk protein (with lactose removed).

Nine-tenths of all meat on the world market goes to the U.S. and Europe. The U.S. has bypassed the United Kingdom as top ranking beef buyer. The entire terminology in this area is misleading. There is in effect no global flow of animal products. It is a matter of delivery to a limited number of choice customers. For a long time "world trade" in butter was nothing else than purveying to the U.S., with New Zealand and Denmark as chief providers. Pork is almost exclusively an inter-European exchange. Poultry meat moves from the Netherlands to West Germany. Reconstituting dairies in Latin America (Venezuela, Mexico) and Southeast Asia (Malaysia, Philippines, etc.) receive some nonfat milk solids, but again largely to serve more affluent consumers, often in the Western business strata. Yet this milk import surpasses by far the milk production of these countries, and in many instances exceeds the

TABLE VII

1967-69 Import Balance of Milk Protein, 1000 Metric Tons

Country	Milk production (in protein)	Import (dry milk) (in protein)
Thailand	0.096	6.56
Philippines	0.51	17.7
Taiwan	0.48	3.7
Ivory Coast	0.29	1.25
Trinidad	0.73	2.55
Jamaica	1.49	3.40
Lebanon	1.98	2.60
Barbados	0.24	0.29
Ceylon	4.2	4.0
Cuba	18.0	12.3
Venezuela	24.8	9.7
Haiti	0.62	0.24
Tunisia	5.75	1.76
Dominican Republic	8.2	2.4
Peru	19.3	5.6
Japan	141	34.2
El Salvador	7.5	1.82
Nigeria	12.9	2.75
Morocco	14.0	1.82
Guatemala	7.95	1.00
Netherlands	254	34.4
Mexico	93.3	9.45
Belgium	124	12.1
United Arab Republic	31.4	1.64
India	304.0	15.0

TABLE VIII

1968-69 World Trade: Animal Protein, Million Metric Tons

Commodity	Product wt	Protein	Sum	Per cent world production[a]
Meat				
Fresh	3.98	0.6		
Bacon and ham	0.44	0.07		
Dried (46%)	0.28	0.13		6.1
Canned (15%)	0.75	0.11	0.91	
Milk				
Dried (35%)	1.21	0.42		
Cheese (25%)	0.72	0.18		8.8
Condensed and evaporated (7.5%)	0.68	0.05	0.75	
Eggs				
Fresh (6%)	0.32	0.0192		
Dried (50%)	0.0085	0.0043		3.1
Frozen (12%)	0.06	0.0072	0.031	
Fish				
Fresh and frozen	1.80	0.27		
Dried	0.26	0.20		
Salted	0.23	0.06		27.8
Canned	0.56	0.07	0.60	
Shellfish	0.40	0.06	0.06	11.0
Fish meal[b]	3.40	2.40	2.40	

[a]Production of each basic commodity: meat, milk, eggs, fish, etc.

[b]Some meal made from waste (statistics do not allow computing an accurate percentage figure) but is ca. 70% of world production of fish meal.

TABLE IX

Aquatic Catches, Million Metric Tons

Commodity	1948	1959-61	1969-70	Gain
Ocean fish catches	14.7	29.2	49.3	24.6
Food fish	12.2	20.6	26.0	13.8
Feed fish	2.5	8.6	23.3	20.8
Shellfish	2.3	3.5	5.5	3.2
Freshwater fish	2.4	6.6	8.6	6.2

intake of fish protein; yet this is playing a much greater role in providing animal protein to far more millions, due to a more equitable distribution and to lower prices.

Even dried milk (nonfat milk solids), which could be an ideal trade item, is basically a Western operation. The Netherlands, a leading exporter for years, has in addition become a major importer, buying (later 60's) from the U.S. more than the "poor world" received to sustain a profitable veal production (chiefly sold to Italy). This pattern is in particular surprising as nonfat milk solids are well suited to various kinds of protein supplementation, e.g., reconstituting of milk in dairies or additive to flour, sausages, biscuits, etc. World trade features further accentuate the low profile of animal products (Table VIII), both in volume and in regard to global nutrition.

TABLE X

1967-68 Percentage of Fish Protein in Animal Protein Intake

Country	Intake	Country	Intake
Cambodia	83.5	Venezuela	28
Congo (Brazz.)	71.0	Peru	23
Indonesia	65.5	Norway	19
Ceylon	65	China	18
Ghana	59	Spain	17
Japan	52.5	Denmark	18
Philippines	50	Chile	13
Thailand	50	India	11
South Korea	49.5	Italy	9
Senegal	46	USSR	8.4
Malaysia	45	Mexico	5.6
Ivory Coast	43.5	Canada	4.8
Jamaica	41.5	U.S.	4.7
Portugal	38	Argentina	2.6
Iceland	30.5		

AQUATIC PROTEIN

At this stage of analysis we need to bring world fisheries into focus. The advances in fisheries in the postwar period have been still greater than those in agriculture. Ocean catches (Table IX) have more than tripled, but here again the lion's share has gone into feed to sustain the animal production of the Western World and Japan. Almost half the catches move as meal into the feeding troughs of the affluent world.

Pollution has nearly eliminated freshwater fish as a source of food in the industrialized world. Freshwater fish is chiefly vital to the developing world, in particular China, Southeast Asia and tropical Africa.

Aquatic protein provides the human household with almost as much protein as does beef (5.7 million metric tons). In many hungry countries aquatic protein dominates the intake of animal protein. Despite recent efforts in Japan to switch to a Western diet, ca. 52%of its animal protein intake is attributed to fish and shellfish. But, in addition, a major part of its animal production is ocean-based via fish meal. In such relative terms fish is most important to China, Japan, Southeast Asia and tropical Africa, only then followed by Europe (Table X).

Another way of elucidating the relative significance of fish is to relate it to the milk production of respective countries. This at the same time mirrors the low level of milk production in Asia and Africa, which still accentuates the paramount role of aquatic protein. Furthermore, Table XI demonstrates in telling figures the solid contribution the oceans make to animal feeding, primarily in the Western World, thereby outmatching in several instances the dairying in terms of involved protein quantities.

Assuming an overall conversion efficiency (return as protein) in animal production of 1:2 through such high quality fish protein, one-seventh (15%) of the animal protein production (Table XII) in which fish meal is traditionally used would originate from ocean sources. But taking into account that at the most one-third of the hog production, and half of the egg and poultry output is the result of such high pressure feeding, this marine percentage climbs to almost one-third were fish meal or solubles are actually in use. The amount of fish protein put into U.S. animal production exceeds, for instance, the amount of protein contained in the annual broiler output. These sectors of U.S. animal production are to a surprising degree

TABLE XI

Fish-Milk Ratio, Grams per Day

Country	Fish protein, F	Milk protein, M	Ratio, F/M	Adj.[a] F	Adj.[a] ratio
Cambodia	16.0	0.3	53.5	—	—
Ivory Coast	5.6	0.4	14.0	—	—
Thailand	6.2	0.6	10.3	—	—
South Korea	4.1	0.3	13.6	—	—
Taiwan	10.0	0.8	12.5	12.6	15.8
Ghana	4.3	0.7	6.2	—	—
Philippines	10.0	1.8	5.6	11.0	6.1
Japan	15.5	3.7	4.2	27.9	7.5
Malaysia	6.6	2.9	2.3	10.0	3.4
China	1.4	0.3	4.7	—	—
Ceylon	5.3	1.8	2.9	—	—
Portugal	12.2	6.0	2.0	15.8	2.6
Jamaica	11.0	6.1	1.81	—	—
Nigeria	1.4	0.8	1.75	—	—
Venezuela	7.4	7.1	1.04	9.6	1.32
Peru	4.2	4.9	0.86	5.9	1.20
Trinidad	6.5	9.5	0.68	6.6	0.70
Spain	6.3	11.2	0.56	16.5	1.47
South Africa	3.8	7.8	0.49	11.2	1.43
Denmark	10.8	24.9	0.43	28.6	1.15
Norway	9.8	24.2	0.41	19.0	0.79
France	5.7	20.8	0.26	10.4	0.50
Italy	3.4	13.7	0.25	7.7	0.56
Belgium	4.4	18.4	0.24	21.6	2.59
United Arab Republic	1.0	4.6	0.22	1.2	0.26
U.S.	3.3	23.2	0.14	9.2	0.40
United Kingdom	4.1	20.9	0.115	15.5	0.74
Netherlands	2.5	22.8	0.11	36.8	1.66

[a]Adj. stands for adjusted taking into account the amount of fish protein, calculated per capita, that is used as animal feed.

ocean-based. These relationships need to be brought into focus and in particular when making predictions as to the future. If restricted to the three mentioned spheres, the global production of such animal proteins amounts to 7.3 million tons of protein. With an assumed conversion of 1:2, 2.15 million metric tons of fish meal protein would render one-seventh of the total.

Half the ocean harvests of fish in *sensu strictu* is currently moving into animal feeding almost exclusively in the Satisfied World (SW), i.e., North America, Europe, USSR, Oceania, Japan, Argentina, Uruguay. In protein quantity this in itself is equivalent to half the protein in the world's beef or 45% of that in the global milk production. This huge influx of protein almost through the backdoor is rarely adequately accounted for in agricultural productional analyses.

ANIMAL FATS OR OILS

The postwar period has seen fats of animal origin reduced in relative volume. Oils and fats of plant sources have in a major way expanded and taken over markets. There are two developments that dominate this scene: (1) the growing dominance of soybeans and sunflower seeds as the raw material base for margarine—soybeans in the West and sunflower seeds in the USSR and Eastern Europe; and (2) the emergence of rapeseed as an oilseed crop for northern latitudes. Peanuts and cottonseed have both shown notable gains in the 60's, but conforming to

TABLE XII

1968-69 Global Production of Selected Animal Proteins

Commodity	Protein, million metric tons
Pork	4.7
Poultry	1.6
Eggs	1.0
Total	7.3

TABLE XIII

Gains in Production, Million Metric Tons

Commodity	1948-52	1970	Increase	Per cent
Soybeans	15.95	46.52	30.57	192
Peanuts	9.64	18.14	8.50	88
Sunflower seed	3.90	9.65	5.75	147
Rapeseed	2.82	6.50	3.68	130
Palm oil	1.01	1.77	0.76	75
Cottonseed	13.94	22.07	8.13	58

TABLE XIV

Aquatic Oils, Million Metric Tons

Oil	1948-52	1968-69	Per cent change
Total	0.72	1.24	+72.5
Whale	0.47	0.075	-56.5
Sperm		0.130	
Fish liver and body oils	0.25	0.946	+280

TABLE XV

Fats and Oils (HW), Million Metric Tons[a]

	1962			1985 (projected)		
Continent	Production	Export trade	Domestic use	Production	Export trade	Domestic use
Africa, south of Sahara	2.87	1.42	1.45	5.70	2.62	2.08
Asia	5.68	1.30	4.38	14.08	3.25	10.83
Others	0.35	0.15	0.20	0.87	0.34	0.43
		2.87	6.03		8.21	13.34
	Trade to SW	2.07			6.59	
	HW	0.80			1.72	

[a]According to IWP.

TABLE XVI

Animal Production and Aquatic Harvests, Million Metric Tons[a]

Commodity	1962	1975	1985	Anticipated increases, 1962-85
Meat	12.3	18.7	25.4	13.1
Milk	59.7	80.5	113.5	53.8
Eggs	1.5	2.7	4.4	2.9
Food fish	1965	1975	1985	Increases 1965-85
Total	34.2	47.6	69.0	34.8
HW	15.7	20.2	40.4	24.7
SW	18.5	27.4	28.6	10.1
Feed fish				
Total	18.1	26.5	37.5	19.4
HW	1.65	3.10	7.8	6.15
SW	16.45	23.55	29.7	13.25

[a]According to IWP.

traditional patterns of utilization.

Fish oil continues to expand in volume, but most of its gains have been used to fill the void created by the near collapse of whaling.

Lard has lost ground in particular due to the demand for leaner pork; it declined in the U.S. by one-fourth in the 60's, despite increases in hog production. U.S. exports dropped by half in the same period.

THE INDICATIVE WORLD PLAN

The Indicative World Plan (IWP) (presented by FAO [UN]) is predicated upon traditional concepts placing main emphasis on fats and oils, rather than on their protein counterpart in the shape of seeds, oilcake or meal. Although growth of the world output of fats and oils has been dominated increasingly by temperate zone production, IWP projects the biggest future expansion in HW (Table XV), and with a world trade, chiefly moving to SW as foremost beneficiary with a three-fold increase in volume within 23 years! Domestic use in HW would double, but with slight gains per capita, as population in these areas doubles in ca. 25 years.

Also in the IWP programming (Table XVI) of animal production, the constraints of soil, water and climate figure vaguely, and it is assumed that the major trends in SW, characterized by expanding production of feed crops and abandonment of pasture, will dictate future developments in HW. This is predicated on the assumption that HW can allow itself to transfer tilled land from food to feed crops, yet only feasible on a very limited scale. On the other hand, HW can ill afford not to utilize its grasslands as pastures. In many instances this is the most rational use of such lands, which cannot be plowed but via ruminants render a return in meat and milk. This explains why China in the postwar era has supported sheep and cattle raising in its western pastoral regions, while hogs and poultry as scavengers have been favored in the overdeveloped coreland. There are in principle two contrasting roads to accommodation in optimizing the production of human food, but both are largely determined by climate and topography: (1) through ruminants whenever primary production not directly utilizable to man is available; or (2) via waste recycling and upgrading through hogs, poultry, rabbits, etc.

However it is still more crucial that these analyses do not recognize the dual nature of HW, consisting on one hand of countries seriously overpopulated and suffering from severe overdevelopment in the use of soils, pastures, water, etc. Heavy overgrazing, grave soil erosion, mineral depletion and falling water tables are some of the indications. Critical malnutrition and high disease frequency among people, animals and crops are other consequences. The ratio between livestock and man is persistently dropping and is not far below world average in major parts of HW.

Land acreage (tilled land and pastures) available to man and beast is dismally low, even less than one-fifth of an acre with no or minute margins for expansion. To all these countries, fish will remain their only chance of dietary improvement. Only a few countries of tropical Africa and Latin America have yet a development margin and are in the category presumably envisaged by IWP.

In terms of aquatic protein (Table XVI), the IWP assumes that SW is going to continue to tap the oceans for feed and raw material for the production of food fats. Current trends do not support the likelihood of the anticipated jump in food fish catch in HW between 1975-85. Overfishing and destructive pollution are alarming signs.

REFERENCES

1. FAO 1969 Indicative World Plan, FAO Rome.
2. FAO Trade Yearbook, 1969 and 1970.
3. FAO Production Yearbook, 1969 and 1970.

[Received March 24, 1972]

Center for Health Sciences established

Establishment of a new interdisciplinary research unit, designated the Center for Health Sciences (CHS), has been announced at Lehigh University.

The new Center will focus the research efforts of Lehigh scientists and engineers on control of such diseases as cancer and "snail fever"; understanding how the eye and other parts of the human nervous system function; investigating biochemical and biophysical processes in living systems; and applying engineering knowledge to health problems.

Thomas C. Cheng, Lehigh professor of biology, will head the unit, which takes its place among eight established centers in the University's research spectrum.

Announcement of the Center and its director was made by Joseph F. Libsch, University vice-president for research, who said: "This reflects the growing interest at Lehigh over the past few years in the biomedical sciences and bioengineering, in both research and education at the graduate and postdoctoral levels."

Two years in the planning stage, CHS has been formally recognized by the University board of trustees upon the recommendation of the Lehigh Research Council and the approval of University President W. Deming Lewis.

The Center's organizational structure will include a council, composed of members of pertinent academic colleges and departments, which will assist in formulating policy and guiding programs. Four technical divisions will conduct the Center's research: pathobiology, biological chemistry and biophysics, visual sciences, and bioengineering. ■