Hitachi Omiya City: Food and Energy Survey. What can be done in a crisis?

Our lives have become highly dependent on outside sources of food and energy. Recent media attention has been given to Japan's looming food and energy crisis.[1] As things stand now, if there is a sudden food and/or energy crisis, Japanese society will come to a complete standstill and people will starve. As shown below, it looks as if in the mid-term there are likely to be serious problems with food and energy supplies. What is the situation in the City now, and what can the City do to alleviate suffering in the event of food or energy supply disruptions?

1. Why might a food and energy crisis occur?

1.1 A global food problem is now occurring.

a. Grain stocks are lowest for 30 years.[2]

b. Total grain production is falling. Despite rises in land productivity, global areas of farmland are falling and worsening natural disasters are causing falling production. (This may be partly due to climate change. Example: heavy rain in Iowa, Illinois and Missouri have caused the Mississippi River to flood in many places, causing billions of dollars of damage to crops, especially soybeans and corn).

c. Greater areas of farmland conventionally used for human food production being used for biofuel production.[3]

d. Rising population combined with economic development in developing countries is resulting in high growth rate in consumption of animal protein.

e. Prices of grain and other foodstuffs are rising because of a. to d. and because energy prices (thus fuel and chemical prices) are rising.

1.2 A global energy problem is now occurring.

a. "Peak Oil". The annual global production of crude oil reached a peak in 2005-2006 and is now due to start declining by 3-5% each year. Conventional oil extraction cannot be raised to the point where supply exceeds demand and prices begin to fall. This is one definition of "Peak Oil".[4]

b. "Peak oil" will be followed by the peak of all hydrocarbon production (all forms of oil and natural gas) in the time zone 2012-2015 (or as early as 2010), the peak of coal production around 2025-2030, and the peak of uranium production around 2025-2040. [5]

c. Economic development in developing countries, especially India and China, is resulting in higher consumption of oil and natural gas, causing further pressure on supplies.

1.3 Japan's food and energy self-sufficiency levels are extremely low

a. Japan's food self-sufficiency is 39% (calorie-based), grain self-sufficiency is about 25%.

b. Japan's population is roughly 127.5 million people. Farmland is now about 4.65 million hectares.[6] Efficient Japanese farming can feed 10.5 people per hectare of farmland. Roughly 50 million people. About 39% of the population.

c. Japan's energy self-sufficiency is about 16.7%, or just over 5% if uranium for nuclear generation of electricity is counted as an import.[7]

d. Renewable energy (including hydroelectricity) not reliant on imported fuels now supplies about 4.4% of Japan's primary energy.[8]

e. High prices and uncertain supplies of oil products for agriculture (transport and farm machinery fuel, electricity, chemical fertilizers and other agrichemicals, plastics, machinery spare parts, and so on) may cause a systemic breakdown of conventional agriculture to occur. In this case, the food self-sufficiency of Japan will decline from the present 39% to probably around 25-30%.[9] Note that when this occurred in North Korea from around 1993 onwards, agricultural production halved and has still has not recovered today. fifteen years later![10]

2. How is Hitachi Omiya City (HOC) prepared to face an extended food and energy crisis?[11]

Much of HOC's food and energy is 'imported'

1. Energy self-sufficiency may be effectively zero. If there is a serious energy crisis, much social activity will grind to a halt in days. Almost everything will stop within two weeks.[12] Electricity supply may continue for some time, depending on the nature of the crisis and how the crisis is handled by the national government. It is possible that nuclear power may be available for several months or a year or so, but it will also eventually become impossible without imports or the ability to use gasoline-based transport systems. Planning and prior implementation may help, but in the long-term the only viable response may be lifestyle change.
2. Food self-sufficiency in HOC may now may be in the region of 10 to 20%. Many people produce food in the city. However, almost everyone is reliant on commercial food sources, supermarkets and other retail food outlets. Stocks of food in retail food outlets are likely to last less than a week. Perhaps only three days. People will rush to buy food and hoard it if they believe a food shortage is about to occur. Without foresight, planning, and a certain amount of prior implementation even short-term survival may be difficult.

3. HOC's basic land and population situation

HOC is located approximately 20 km north of Mito City, the capital of Ibaraki Ken, and approximately 20 km inland from Hitachi City, on the Pacific Ocean coast. HOC lies exactly on the northern edge of the Kanto Plain and between the two rivers, Naka River and Kuji River, both of which flow through the town (on the east side and southwest side, respectively). Thus the ocean and the mountains are both nearby, and water resources are abundant. Land areas of HOC are approximately as follows (Table 1):

Table 1. Land areas of Hitachi Omiya City

	area (ha)	% of total area
Total area	34,838	100.0
Upland fields	3,401	9.8
Wet rice fields	2,452	7.0
Mountain forest	20,075	57.6
Waste land	898	2.6

3.1 Population and Farmland (Food self-sufficiency)

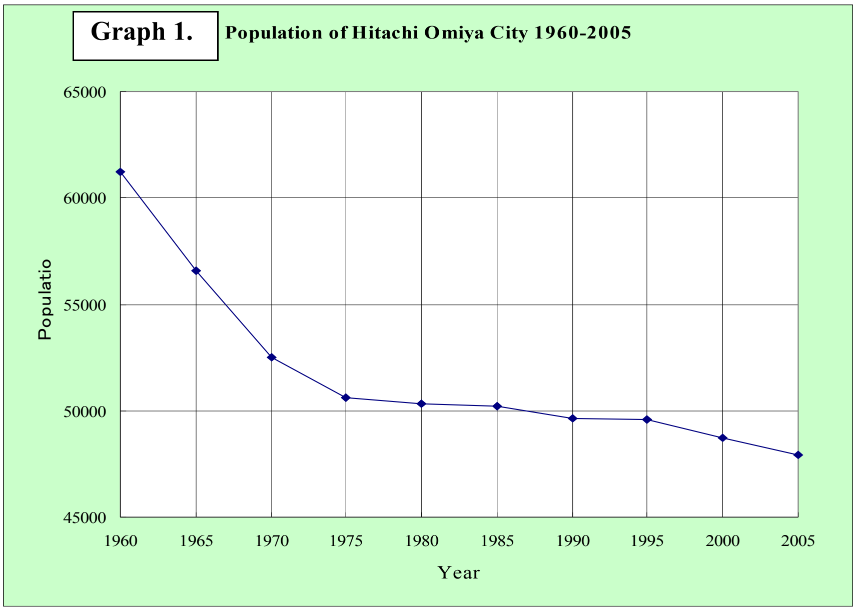
Population of HOC (April 2008) is 47,808, the number of households was 16,029. Graph 1. shows that the population of HOC has declined to its current level from over 60,000 in 1960.

The farmland area of HOC is 5853 ha. The cropping ratio (the average number of crops grown on farmland per year) may be less that 90%, so the area actually planted in the 2000s may be around 5200-5300 ha.

At 10 cap/ha, HOC has 5853 ha of farmland = 58,530 people can be fed, in theory.
At 7 cap/ha, HOC has 5853 ha of farmland = 40,971 people can be fed, in theory.
HOC appears to be theoretically capable of food self-sufficiency at the present population level.

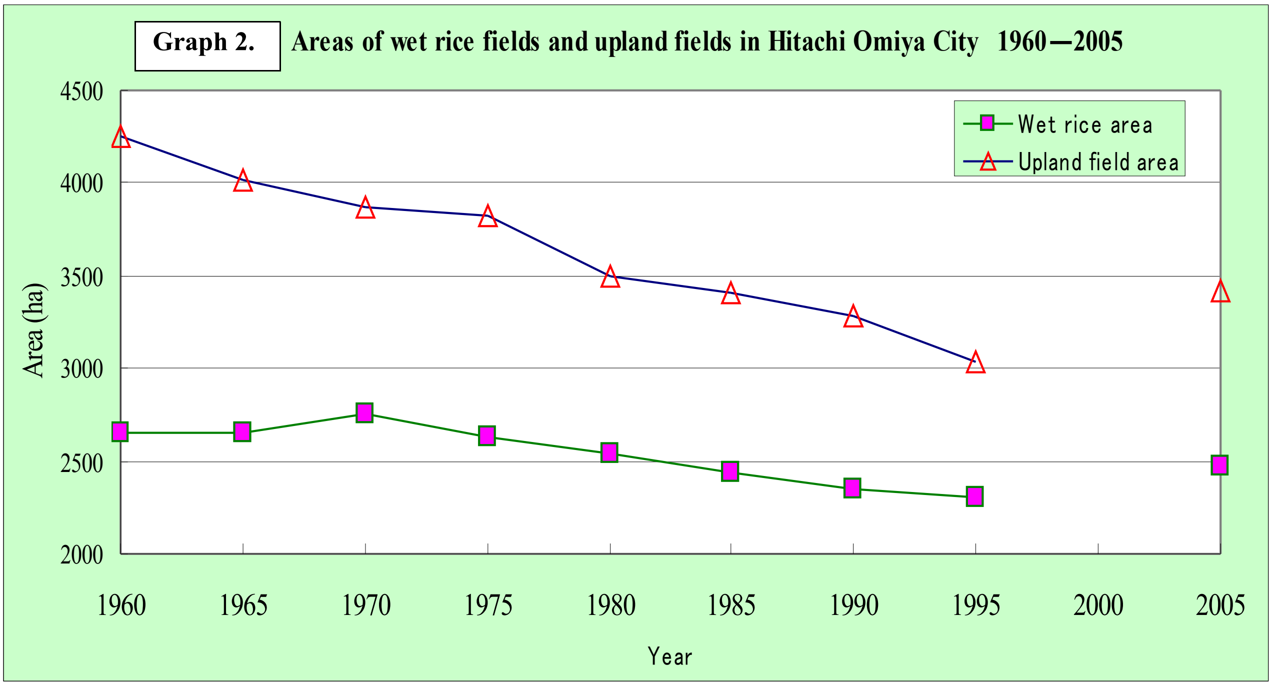
But, wet rice field area is 2452 ha.
1 ha of wet rice land can provide rice for around 45 people per year at 110 kg/cap/yr
(4950 kg white rice per ha)

At 45 cap/ha, HOC's 2452 ha of wet rice land = 110,340 people can be provided with white rice per year. *HOC can perhaps be a net 'exporter' of rice.*



The 3401 ha of upland fields will be needed to provide the population with other foods (vegetables, fruit) and agricultural products. Crops currently produced on upland fields and orchards include wheat, barley, potatoes, sweet potatoes, soybeans, tobacco, tea, tomato, egg plant, bell pepper, cucumber, cabbage, Chinese cabbage, lettuce, spinach, green onion, onion, Japanese radish, carrot, taro, strawberry, watermelon, mushroom, apple, grape Japanese pear, peach, persimmon, sweet chestnut, plum, and blueberry.

3.2 Past data



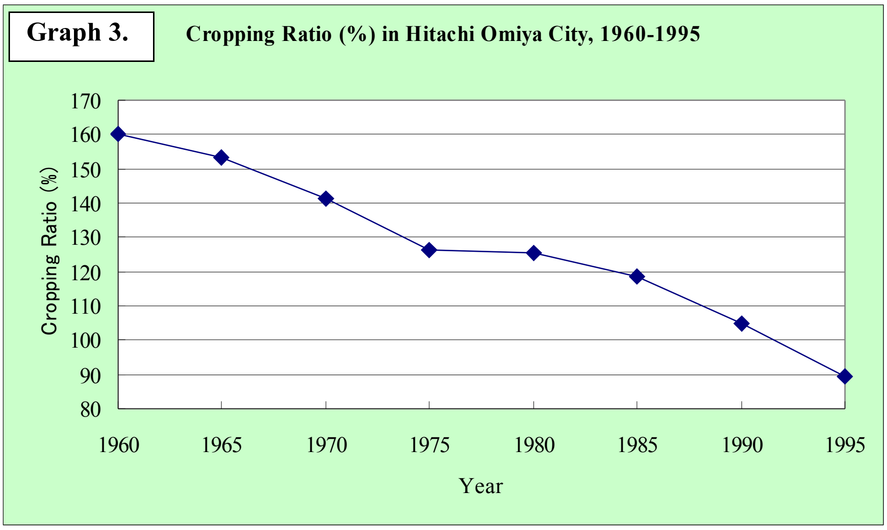
Note: 1960-1995 figures are from “50 Years of Ibaraki Agriculture”, p.96, p.105-108. These figures are based on census data and so are often underreported as they rely on people declaring their farmland areas. 2005 figures are from Hitachi Omiya City’s website. These figures are based on land tax values and so are thought to be far more accurate.

Farmland areas in 1960 were: Total: 6903 ha, wet rice fields: 2654 ha, upland fields: 4249 ha, and the *cropping ratio was on average 160%!* So the planted areas in 1960 were 11045 ha, more than double the present figure. (See Graph 2., 3. and 4., and Table 2.)

All of this farmland is clearly not recoverable, but some may be. It may not be possible to lift the cropping ratio immediately, but 120% may be possible quite quickly.

Table 2. Planted areas in Hitachi Omiya City, 1965 and 1995

(1965)	Wet Rice	Upland Rice	Grains	Veg.	Fruit	Sweet Potato	Potato	Soybean	Peanut
Omiya T.	1300	702	1320	372	52	49	32	132	30
Yamagata T.	426	197	574	144	30	18	13	97	13
Miwa V.	176	111	340	103	22	19	10	36	1
Ogawa V.	329	160	442	123	34	16	10	44	10
Gozenyama V.	235	160	412	113	29	24	13	20	48
Total HOC (ha)	2466	1330	3088	855	167	126	78	329	102
Total planted area: 8541 ha									
(1995)	Wet Rice	Upland Rice	Grains	Veg.	Fruit	Sweet Potato	Potato	Soybean	Peanut
Omiya T.	1110	194	171	184	86	26	17	145	44
Yamagata T.	311	68	67	82	43	8	9	68	17
Miwa V.	102	16	8	60	29	3	7	23	2
Ogawa V.	226	45	27	65	28	3	7	57	3
Gozenyama V.	210	90	33	102	34	10	6	21	4
Total HOC (ha)	1959	413	306	493	220	50	46	314	70
Total planted area: 3871 ha									



Note: A cropping ration of less than 100% means that some land was not farmed in that year.

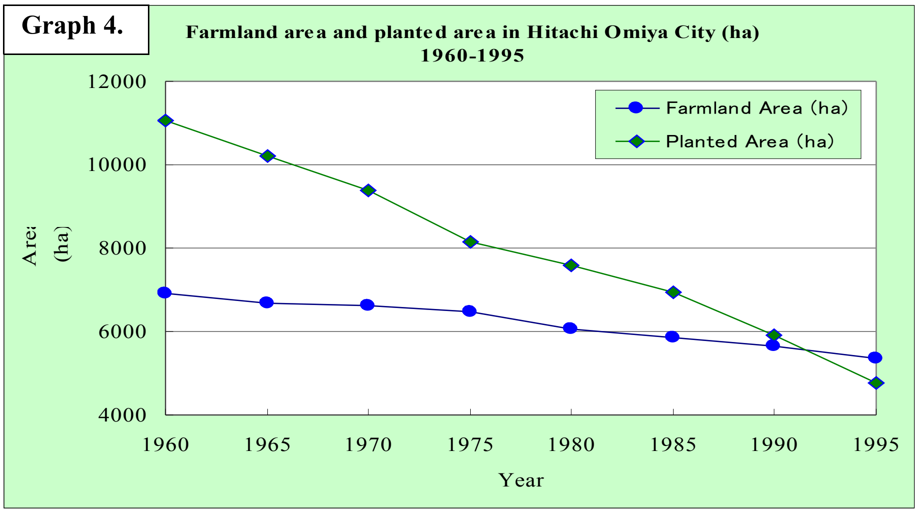
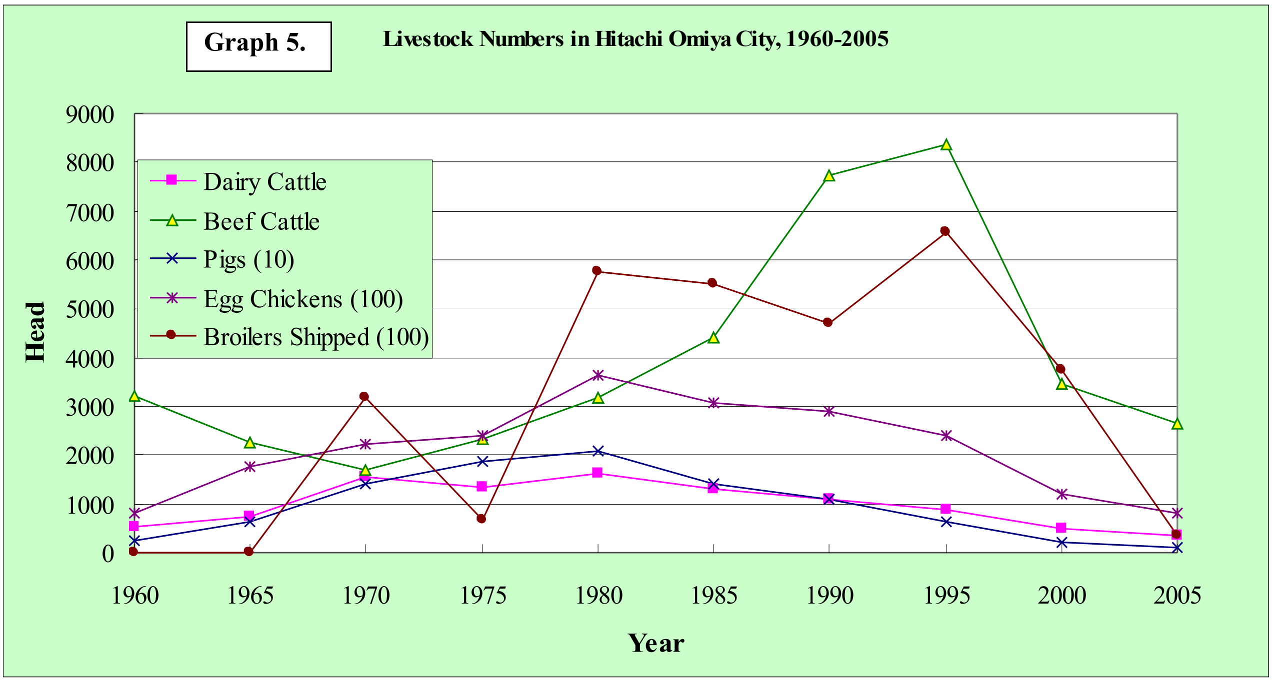


Table 3 and Graph 5 show the numbers of livestock kept in Hitachi Omiya City from 1960 to 2005. Clearly, numbers are falling , but it may not be possible to maintain even these numbers without commercial feed.

Table 3. Livestock Numbers in Hitachi Omiya City: 1960 to 1995

	1960	1965	1970	1975	1980	1985	1990	1995
Dairy Cattle	540	750	1540	1340	1630	1290	1100	870
Beef Cattle	3200	2270	1690	2330	3190	4410	7730	8360
Pigs (10)	240	632	1418	1877	2074	1411	1082	632
Egg chickens (100)	800	1755	2224	2403	3628	3081	2909	2414
Broilers shipped (1000)	0	0	316	67	576	551	468	657



4. Fuel

4.1 What important operations do we need energy for?

Table 4. Changes in energy source in an energy crisis

Operation	**Now provided mainly by:**	**Energy use per household**	**In an energy crisis may be provided for by:**	**Equivalent in alternative energy source**
Cooking food	Electricity, gas	3,517 MJ/yr[a]	Wood, solar?	187 kg/yr dry wood (e.g. branches)
Heating water for drinking or washing and bathing	Electricity, kerosene, gas, thermal solar	13,536MJ/yr[a]	Wood, thermal solar	718 kg/yr dry wood (e.g. branches)
House heating during five winter months November-March	Electricity, kerosene, wood	12,389MJ/yr[a]	Wood	658 kg/yr dry wood (e.g. branches)
Electricity for the household water supply	Electricity	Depends on water supply system	Emergency electricity supply or PV.	Depends on water system. Easily supplied by small solar panel if supplied from a well.
Lighting	Electricity	Varies from household to household	PV, candles	26.3 kWh/yr[b]
Refrigeration (possibly only necessary for specialized needs, e.g. hospitals)	Electricity	385.4 kWh/yr[c]	Emergency electricity supply or PV	385.4 kWh/yr
Transport	Gasoline, diesel, electricity (trains)	Varies from household to household	Rationed gasoline or diesel, ethanol. Possibly charcoal.	Only essential transport
Farm machinery	Gasoline, diesel	110-140 l/ha/yr[d]	Rationed gasoline or diesel, ethanol. Possibly charcoal.	100 l/ha/yr ethanol[e]
Electricity for farming operations: irrigation, post-harvest drying, milling and processing	Electricity	30 kWh/ha/yr[f]	Emergency electricity supply or PV. Sun-drying, manual power, with or without mechanization, e.g. hand-powered winnowing machines.	Perhaps possible with a household 3-4 kW PV panel[g]

Notes:

a. 財団法人　日本エネルギー経済研究所　計量分析ユニット編「エネルギー・経済統計要覧（2007 年版）」財団法人　省エネルギーセンター, p.93. See Table 5 below for calorific value of wood.

b. Based on one 18w light for 4 hours per night for 365 days per year. Easily supplied by one small PV panel.

c. Based on a 300-400 litre family refrigerator running at an average power use of 44W/hr for 24 hours per day (1.056 kWh) for 365 days per year. Easily supplied from a household PV panel of 3-4 kW. Figures from the Seikatsu Club website: http://www.seikatu-cb.com/kiwami/siyou02.html

d. Williams, James H., David von Hippel, Peter Hayes, "Fuel and Famine: Rural Energy Crisis in the Democratic People's Republic of Korea," Institute on Global Conflict and Cooperation, IGCC Policy Papers, Paper #46, March 2000, (http://repositories.cdlib.org/igcc/PP/pp46) p.8-9

e. Assuming ethanol can be distilled from processing of crops that use land other than that used for human food, and that current machinery can be adjusted to run on ethanol.

f. Pimentel, D., (Ed.), *Handbook of Energy Utilization in Agriculture*, CRC Press, 1980, p.96. The figure given here is about 16 kWh/ha/yr for drying harvested rice. Roughly the same amount may be used for other processing.

g. Very heavy seasonal use, but a 3 kW panel might provide 15 or more kWh of electricity on a sunny day.

4.2 How much energy can be obtained from mountain forests?
Since nearly 60% of HOC land area is mountain forest, we can make a theoretical calculation of the amount of wood and energy that can be sustainably harvested per year from those forests.
The amounts of wood and the energy value of harvested wood can be calculated as follows:

Table 5. Calculation of energy value of sustainably harvested wood	
Average annual growth per ha for Japanese forests	13.8 tonnes
Multiply by 0.4 to eliminate leaves and branches	5.52 tonnes
Multiply 20000 ha x 5.52 tonnes for total harvested weight	110,400 tonnes
Multiply by 18.84 10^9 J/tonne to obtain energy value in J	2.08 10^{15} J
Sources: Private interview with Kouichiro Koike at Shimane University, Matsue City, 7 February 2000, and Kishi, Sadakichi, 岸本定吉「森林エネルギーを考える」創文、昭和 56 年 pp.31, 32, 59	

10,977,000 kcal/household × 4.1868 10^{-3} MJ = 45,958 MJ/household[13]

× 16,029 households = 7.3666 10^8 MJ = 7.3666 10^{14} J

7.3666 10^{14} J / 2.08 10^{15} J × 100 = 35% (approximately 2.4 tonnes/household)

35% of sustainably harvested wood from HOC's forests may cover all current household energy needs in HOC (not counting harvested branches).

- Leaves fallen on forest floors may be a very important source of fertility for farmland.
- Branches may be used directly as fuel for household uses or converted to charcoal for various uses, including transport, perhaps.

However, much will depend on:
1) The condition of the forests,
2) The (predominant) kinds of trees in the forests
3) Forest ownership (private, municipal, prefectural, state, etc.)[14]

Wood will also be needed for construction purposes and for other purposes such as furniture-making and so on. All of this will have to be carried out in an orderly and organized manner. It *must* be done sustainably. The forests should not be destroyed or downgraded for short-term reasons, in fact the opposite. The forests should be slowly expanded and improved so as to provide maximum sustainable productivity for future generations.

5. Problems

5.1 Motive power
In the event that gasoline and diesel fuel are in short supply, food production and important transport uses need to be given first priority for fuel stocks.

Electricity: Electricity can be produced using diesel generators, but this will compete with fuel for other uses. Planning will be necessary. In the long-term, the use of hydroelectricity, photo-voltaic cells, wind turbines, and fuel cells may be possible. However, there are very few of these in HOC at the moment and may not be available after a crisis occurs.[15]

Traditionally, motive power is from three main sources, wind, water and draught animals. HOC may be able to make use of water power from the two rivers, Naka River and Kuji River. In this part of the country, the most commonly used draught animal was the horse. However, there are effectively none in the city at present and it is not known how stocks can be built up. *Building up stocks of draught animals is a long-term issue that needs to be addressed on a regional basis.*

5.2 Fertilization

As oil and natural gas become more expensive and less easily available, the price of chemical fertilizers and other agrichemicals will also rise and there may be disruptions in supply (for example due to non-availability of fuel for transport). The price of phosphate fertilizers are now rising[16], as are prices of nitrogen fertilizers, due to the rise in prices of oil and natural gas. Alternative fertilization techniques are fairly easily available, *but it will require foresight and planning to make use of these quickly once a food and energy crisis begins.*

a) As mentioned above, leaf mold can be made available from forests.
b) All types of composting, associated with sustainable agriculture (SA) practices, will be very useful. SA includes organic farming, permaculture, biodynamics, mixed farming and so on. These techniques are well documented and there may be some farmers with good experience with these SA practices in the City.

5.3 Experience of farming and sustainable farming

One of the problems of a combined food and energy crisis is that the lack of fuels for farm machinery and chemical fertilizers for field fertilization makes continuation of conventional farming extremely problematical, as was the experience in North Korea in the 1990s. Given the lack of draught animals, and possible lack of fuels and electricity, even if large numbers of people take part in farming activities, some operations may prove to be difficult. Examples:

- Irrigation: there is very little substitute for electricity-driven irrigation pumps.
- Rice transplantation. If wet rice fields are used to grow a second crop, the timing of the harvest of this crop and the transplanting of the rice may require fast and heavy work.
- Harvest and post-harvest. the chain of harvesting, drying, transport of produce for processing, pre-processing drying (or drying for storage), processing, transport to consumers is a serious bottleneck that will have to be overcome if an adequate food supply is to be maintained.
- SA composting and other techniques are also very labor-intensive, and require large labor inputs in the first three years or so of a transition from the current forms of conventional farming. *That is why it is best to start such projects well before the crisis becomes serious.*

All of this will then be dependent on people having experience of farm work. However, the current farm population of HOC is shown in Table 6.

Table 6. Number of Farming Households in Hitachi Omiya City, 2005

Total	Full-time	Type 1	Type 2	No. of people	Subsistence Farmers
4855	723	268	1884	11005	1980

Members of Farming Households in Hitachi Omiya City, by Age, 2005

Age	Total	Male	Female
0-14	967	496	471
15-29	1609	818	791
30-59	3586	1870	1716
60-64	715	347	368
65 and over	4128	1940	2188
Total	11005	5471	5534

Source: 平成 19 年版「統計常陸大宮」(2007 Statistical Data for Hitachi Omiya City), p.13-14
Notes: Type 1 Farmers: Farmers whose main work and source of income is farming, but who also have other work. Type 2 Farmers: Farmers whose main work and source of income is other than farming. Subsistence farmers: Farming households with less than 0.3 ha farmland or whose annual sales of produce are less than 500,000 yen.

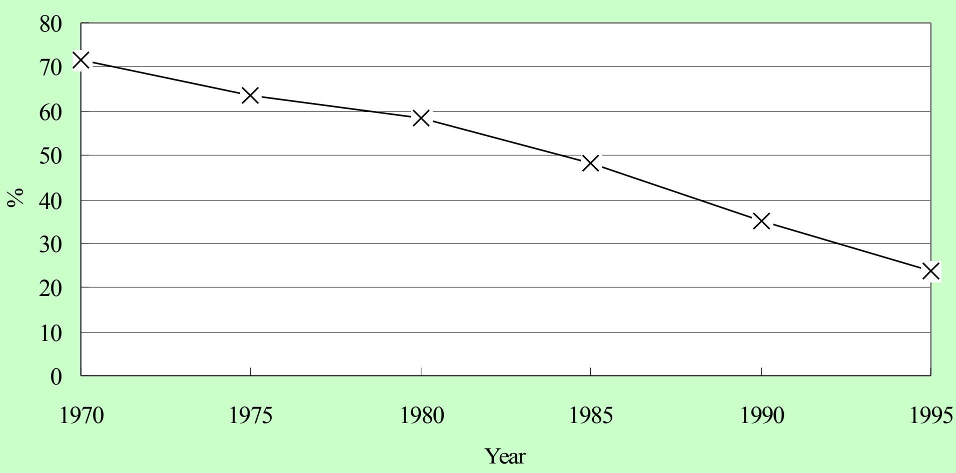
Table 6. shows that about 23% of the population are members of farming households, a total of 11,005 people with possible actual farming experience. However, there may be many older people who have farming experience, but who do not farm now. Their experience as work leaders may be valuable. Many of the people who are currently farming are also older people, as can be seen from the skewing of age of members of farming households towards the higher age ranges. See also Table 7. and Graph 6 for historical data on the proportion of farmers under 60. Even in farming households, it may be that the older generation are directly involved in farming while the younger people have salaried jobs in other sectors (Type 1 and 2 farming households). The younger generation may thus have varying degrees of actual farm work experience. It will be necessary for older, experienced farmers to teach younger people how to do farm work correctly and efficiently.

Table 7. Proportion of farmers in Hitachi Omiya City under 60 (%) 1970-1995

1970	71.66
1975	63.72
1980	58.50
1985	48.38
1990	35.08
1995	23.86

At least 80% of farming people are now over 60 years of age. The historical aging of farmers in Japan is a matter of great concern, since it possibly represents the sudden loss of practical farming knowledge and skills in the near future.

Graph 6. **Hitachi Omiya City, Proportion of farmers under 60 (%) 1970-1995**



5.4 Farming and Gardening Hand Tools

Farm work by hand will require tools (spades, forks, hoes, trowels, ploughs, and so on) There may be insufficient tools in the City for everyone to use. It may be possible to produce some new tools, or remake or repair old tools. In the long-term, it will be necessary to build the capability to manufacture tools, but that may, for example, require the 'import' of iron. In the mid- to long-term, blacksmiths will be required.

5.5 Diet change.

The diet now and the diet following a severe food and energy crisis will not be the same. Following a severe crisis people will have to:

- Eat less – hopefully an average of 2300 kcal/cap/day will be maintained or exceeded.
- Eat more "traditional foods" – rice, locally grown and seasonal fruit and vegetables (including

more tubers), traditional preserved foods,

- Eat/drink less: animal protein (milk, eggs, meat, fish), sugar, commercial drinks and fruit juices
- It may take some people quite a long time to get used to this change.

5.6 Population influx

If there is an extended food and energy crisis in Japan, almost the total city population will want to move from city areas where no food can be produced to rural areas where food may be available. HOC's capability to be self-sufficient in food may very quickly be overwhelmed by large numbers of people moving away from Mito or the Tokyo area. How will the City deal with this? There will need to be planning and policy-making beforehand. "Refugees" from the cities will require food and shelter. To what extent can these, and longer term residence, be afforded to such people without jeopardizing the livelihoods of the citizens of HOC? A public debate may be necessary before policies or guidelines are drawn up.

5.7 Population relocation

As a partial answer to 5.6 on a national scale, population relocation in order to get people living where food can be produced, and prevent large and uncontrolled movements of people as a response to a food crisis, is a huge and important issue that should be considered, but is thought to be outside the scope of this study for two reasons: 1) This is a city survey and population relocation is a national problem. The city may make policy guidelines, but the issue will be resolved by policy, or lack of it, at national level. 2) What the majority of urban dwellers will do in the event of a severe food/energy crisis is not easily predictable. It will partly depend, of course, on what the government tells people to do. Some urban dwellers may decide that their best course of action is to leave the city (e.g. those with direct links to rural areas through relatives and so on), but many urban dwellers may also decide to stay where they are, preferring to be close to stocks of imported food and national or local authority food stockpiles, where they exist, perhaps in the realization that there may be more immediately available food in the cities than in the rural areas.

6. In the long run

The above sections 1-5 refer to short- and mid-term responses to a sudden food and energy crisis. In the case of a severe, long-term crisis, where all imports of food and energy cease for a long period of time, or permanently, the following elements must be provided for a decent social existence to continue: Food, Water, Shelter, Clothing, Medicine and Healthcare, Education, Security, Money and Financial Services, and Energy

6.1 Food. Largely dealt with above. Sources of animal protein (cattle, pigs, chicken, fish) will be an issue that will have to be carefully considered. Livestock will have to be fed grass or forage in the mountain forests and/or eat household scraps, NOT grain feed.

6.2 Water. HOC has ample water resources. These should be carefully conserved. One problem may be electrical pumps for the water system.

6.3 Shelter. The existing stock of buildings will have to be used and repaired for use as much as possible. Buildings which currently cannot function without electrical power and so on may have to be altered to be useful, though there are relatively few of these in HOC (supermarkets and large retail outlets are one example). In the more distant future, new buildings (dwellings and so on) will be built from wood. It will require careful and sustainable management of the forests for this to be possible.

6.4 Clothing. The existing stock of clothing will have to be used for the time being. These will have to be repaired and remade. In the future, the production of materials for clothes-making will have to be produced, e.g. cotton and wool. This will, of course, compete for land which can be used for human food.

6.5 Medicine and Healthcare. Medical facilities and the personnel who staff them will continue to exist. However, the lack of modern medicines and electricity may make current medical practice extremely difficult. Traditional herbal medicines and so on may have some part to play in the future of healthcare.

6.6 Education. School buildings and the personnel who staff them will continue to exist. The form that education will take following a severe food and energy crisis will have to be built up on the basis of public debate.

6.7 Security. Presumably, the police system will continue to exist, though how all local government services will link to the central state system is something that cannot be prescribed or predicted. Since some form of social security (defense of people and property) will be necessary, if the police and self-defense systems collapse or are not available locally, it will be necessary for the City to devise some kind of system for HOC.

6.8 Money and Financial Services. Although exchanges based on money will almost certainly decrease, some kinds of money and financial services will be necessary in order to continue to carry out local and trade-type (with other towns, cities or prefectures) exchanges of goods. The establishment of a local money and local banking system may be necessary.

6.9 Energy. The City will have to look at existing and potential energy sources within the city and formulate some kind of energy plan or policy. Many energy initiatives will be individual or small group, very local efforts to provide energy for households or for a few households as a group unit. (Use of local resources – forest, water, wind, geothermal, biogas, and so on.)

Finally, it will be necessary to plan and create policy so that positive aspects of the “new” lifestyle outweigh the negative aspects.

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[1] Examples are:

- 食料白書編集委員会、「2008 (平成 20)年版　食料白書　食料とエネルギー、地域からの自給戦略、エタノールによる資源利用の競合と今後の方向」、農山漁村文化協会
- 「日本が餓え死にする」エコノミスト、2008 年 4 月 1 日、pp.22-39
- 『「日本の飢餓」重大警告は無視された』週刊文春、2008 年 7 月 10 日、pp.142-145

[2] Grain stocks: e.g. 2008: The year of global food crisis, http://www.lavalnews.ca/articles/TLN1612/foodCrisis161206.html

[3] Biofuel problem: e.g. Ethanol bites into world grain stocks, http://www.peopleandplanet.net/doc.php?id=2895

[4] Regarding "Peak Oil", see http://en.wikipedia.org/wiki/Peak_oil

[5] Regarding the annual production peak of conventional oil and the hydrocarbon peak, see e.g. ASPO Newsletter No. 90, June 2008, p.2, available at: http://www.aspo-ireland.org/index.cfm/page/newsletter
Regarding the annual production peak of coal, see e.g. *Energy Watch Group, Coal: Resources and Future Production,* March 2007, EWG-Series No 1/2007, p.7
Regarding the annual production peak of uranium, see e.g. *Energy Watch Group, Uranium Resources and Nuclear Energy,* December 2006, EWG-Series No 1/2006, p.6

[6] 農林水産省大臣官房総括審議官　伊藤　健一　「世界の食料事情と日本の食料安全保障」平成 20 年 5 月 23 日、p.17

[7] 財団法人　日本エネルギー経済研究所　計量分析ユニット編「エネルギー・経済統計要覧（2007 年版）」財団法人　省エネルギーセンター, p.18-19

[8] 同上

[9] In North Korea, Agricultural production in the mid-nineties roughly halved compared to the mid-eighties.（See note 10）See also 高木　尚「**食糧･エネルギー危機**」、http://izumo.cool.ne.jp/kitona/

[10] Boys A., The Limits of Energy-Based Agricultural Systems and the "North Korean Food Crisis", 2004, http://www9.ocn.ne.jp/~aslan/dprkeng0409.pdf, and BBC News, "UN strikes food deal with N Korea" 30 June 2008, http://news.bbc.co.uk/2/hi/asia-pacific/7480800.stm

[11] Statistics for Hitachi Omiya City for the period 1960-1995 are from 「茨城農業の 50 年」 (50 Years of Ibaraki Agriculture), p.96, p.105-108, and are the result of a summing of the statistics for the former Omiya Town, Yamagata Town, Miwa Village, Ogawa Village, and Gozenyama Village.

[12] In September 2000, road hauliers blockaded British oil refineries in protest against fuel taxes, preventing petrol (gasoline) reaching petrol stations. Normal life in Britain was stopped in less than two weeks and petrol had to be rationed for essential services (medical, police, fire, etc.)
BBC, Coping on empty, 3 November, 2000 http://news.bbc.co.uk/2/hi/uk_news/politics/1003305.stm
The UK Fuel Protests of September 2000, http://www.bbc.co.uk/dna/h2g2/A735022
In the event of a severe energy crisis in Japan, gasoline stocks are unlikely to last more than a week. Strict rationing procedures will probably be introduced much sooner than that. Japan has around 170 days of crude oil (about 730 million barrels) stockpiled for emergencies, 91 days in government stockpiles and 79 privately controlled. I assume that in the case of an extended energy crisis, rationing will be introduced and energy will be made available preferentially to essential services – national security, police, medical services, fire services, food transport, and so on.

[13] 財団法人　日本エネルギー経済研究所　計量分析ユニット編「エネルギー・経済統計要覧（2007 年版）」財団法人　省エネルギーセンター, p.93

[14] A large percentage of HOC'S forests are 杉, "*sugi*" (Cryptomeria japonica), probably planted in the post-war period of a shortage of construction wood. These forests are good for construction wood, but may be unusable for fertilizer or burning for heating.
Forest ownership: According to the 2005 年版茨城県農林業センサス(2005 Ibaraki Prefecture Agricultural and Forestry Census), p.208, HOC's forest area is 21,153 ha (of a total area of 34,838 ha; 59%), of which 11.9% (2,521 ha) is state-owned, 84.6% (17,892 ha) is privately owned, and 3.8% (814 ha) is publicly owned. (Figures rounded)

[15] Note on renewable energy: According to the Environment Department of the City Office, there are two public sites

which have PV panels, the City Office itself has 20 kw and the Yamagata Middle School has panels of 10 kw. Neither of these panels can be used in the case of a power blackout; they are merely for CO_2 emissions reduction. It is possible they can be adapted for use off-grid if necessary. The City Office is offering subsidies to encourage PV panels on private houses: 45,000 yen per kw, and a maximum of up to 4 kw (180,000 yen). Between 2002 and 2007, 123 subsidy applications were granted (440.38 kw). The City Office also offers subsidies for "Ecocute" efficient electrical water heaters (60,000 yen per unit). These heaters use night-rate electricity and store hot water for later use. They also use about one-third of the energy to heat water when compared with similar gas or kerosene heaters. This is being carried out as part of a CO_2 emission reduction program.

[16] Regarding phosphate prices, see e.g. "World fertilizer prices soar" http://www.eurekalert.org/pub_releases/2008-05/i-wfp052308.php