

Post Disaster Availability, Consumption and Balance of Food and Needed Agriculture Strategy for the Livelihood Recovery and Economic Resilience in Gorkha, Nepal

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Abstract

Barpak earthquake 2015 killed and injured thousands of lives and millions became homeless. It created food shortage and hardship on livelihood because of damaged agriculture infrastructures, loss of stored foods, feeds, seeds, death of livestock's and reduced harvests. The aim of this research was ascertaining post disaster trend of food and nutrition availability, consumption and food balance in Gorkha, in order to assure livelihoods support and economic resilience. Relevant literature were reviewed, field verification and interactions were made in different rural/municipalities in the year 2019. The study revealed that Gorkha is self-sufficient and surplus in cereals (49.7%), fruits (6.2%) and spices (175.7%), although Chun Numbri, Bhimsen, Gandaki and Sahid Lakhani rural municipalities are seriously deficit in cereals (101, 661, 333 and 1799 MT/year respectively). Gorkha is deficit in poultry eggs (65.0%), meat (54.0%) and pulses (53.0%). However, Chun Numbri and Dharche in meat and Palungtar and Ajirkot in pulses are in surplus. Gorkha is moderately deficit as regards to vegetables (31.5%), potato/tubers (30.0%) and milk (29.6%). However, Chun Numbri, Gandaki and Bhimsen are surplus in vegetables, Chun Numbri, Dharche, Siranchok and Arughat in potato and Gandaki, Dharche and Ajirkot in milk production. Moreover, Gorkha is seriously deficit in sugar (100%), fish (99.1%), oilseed/ghee (92.5%) and honey (92.7%). Thus, Gorkha needs to have its own agriculture development strategy for local food security and livelihoods with commercial agri-programmes for economic resilience. These should include high hill potato/potato seed production in Chun Numbri, medicinal herbs in Dharche, hill maize/maize seeds in Barpak Sulikot, agro-forestry of utis/timur/white sandal intercrop with cardamom/tea/coffee in Ajirkot, goat production in Siranchok and Arughat, avocado in Bhimsen, citrus in Sahid Lakhani, organic vegetables in Gandaki and Gorkha and milk/fruit production in Palungtar. All development programmes, farmers' welfare programme, agro-tourism and resources should be integrated with the focus programme for the livelihoods and economic resilience of the earthquake victims in Gorkha.

Key words: food, nutrition, deficit, livelihood, resilience.

Background

Nepal falls under seismic zone having earthquake greater than seven rector scale in each 70-80 years. There was a serious earthquake of 7.8 rector scale in 2015 and the epicenter was Barpak of Gorkha district (Wikipedia, 2015). The earthquake killed more than 8,800 people and injured nearly three times as many (Nepal Disaster Risk Reduction Portal^a, 2015; Jason and Rauniyar, 2015; Nepal Disaster Risk Reduction Portal^b, 2015). Nearly 3.5 million people became homeless (National Emergency Operation Centre, 2015).

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Thousands of houses were destroyed across many districts, with entire villages flattened, especially those near the epicenter (Shrestha, 2015; McCarthy, 2015 and Kaini, 2015). Concern was expressed that crop harvests could be reduced or lost this season as people affected by the earthquake would have only a short time to plant crops before the onset of the Monsoon rains (The United Nations News Centre, 2015). There was a loss of thousands of agriculture infrastructures like livestock/poultry shades, irrigation channels and storages. Thousands of productive livestock's were killed. A big volume of the stored foods, feeds and the seeds were damaged creating food shortage and hardship on livelihood of the earthquake victims. In this situation, it was utmost necessary to find the post disaster trend of food and nutrition availability, consumption and food balance in Gorkha in order to livelihood recovery and economic resilience for the earthquake victims.

Gorkha is one of the geographically diversified districts in Gandaki Pradesh, politically divided in to 11 rural/municipalities. The climate ranges from southern tropical belt (300-1,000masl) to subtropical, temperate, subalpine, alpine and nival with trans-Himalayan (3,000 to 6,400 masl) belts in the North. Where, Chun Numbri, Dharche, Parpak Sulikot and Ajirkot are in the north, Siranchok, Gorkha and Palungtar are located in south-west and Arughat, Bhimsen, Sahid Lakhan and Gandaki in south-east areas (Wikipedia. 2020). The staple foods, availability and balance vary on geography. The municipality wise population, cultivated area (ha) and livestock population are given in table-1, below:

Table-1: Population, cultivated area (ha) and livestock population in Gorkha

SN	Rural/ Municipality	Population	Cultivated area (ha)			Livestock (Number)					
			Irrigate	Rainfed	Total	Buffalo	Cattle	Goat	Sheep	Chicken/duck	Pigs
1	Chun Numbri	7417	130	1832	1702	10	1500	20250	10530	30245	150
2	Dharche	13264	155	3099	3159	3450	7720	22580	10848	35570	580
3	B. Sulikot,	25399	1635	3272	4907	1500	7150	20890	3662	45700	1500
4	Ajirkot	15602	2176	1729	3905	8554	9856	24325	5240	48240	1000
5	Siranchok	23666	1289	2071	3360	8988	9277	18347		41300	2040
6	Arughat	23915	735	7244	7979	8690	7633	17180		42100	1840
7	Bhimsen	22053	1229	1698	2972	9832	7634	16241		40340	730
8	S.Lakhan	27555	971	1733	2704	9834	9435	18603		44380	1803
9	Gandaki	23262	1012	1836	2848	7776	9497	18603		43250	60
10	Gorkha	50684	3242	2282	5524	5357	7322	15580		42240	80
11	Palungtar	38244	2451	6537	8988	6681	7757	15870		42580	71
	Total	2,71,061	14,744 (30.6%)	33,438	48,182	69,672	84,781*	2,08,468	30,280	4,56,245	11,762

Note: Chauri= 4,630

Source: AKC Gorkha, 2075

The post disaster priority of Nepal Reconstruction Authority was on housing and infrastructure support rather than the food security, livelihood and economic resilience for the earthquake victims in Gorkha. However, Pearl S. Buck (1892-1973) argued that a hungry man can't see right or wrong, he just sees food. There is a strong legal provision and projects/programs for the food sovereignty and right to food in Nepal. A new project "Food and Nutrition Security Enhancement Project" has been recently initiated, targeting the livelihood recovery and economic resilience of the earthquake affected communities in different 8 districts including Gorkha. The Local Governments, Provincial Governments and Federal Government are involving for to meet the demand of the earthquake victims in post disaster period. However, all these efforts seem insufficient for livelihood recovery and economic resilience of the people. The food access is decreasing because of low production,

availability and low purchasing power. There lacks a well developed collection and distribution system. Marketing net work is weak; rice culture is prevailed with ignorance of food diversification and local food products. Over all situations including, seems low level of investment in agriculture, there are poorly coordinated, overlapped, duplicated and donor dependent food security programs, private sector role is non-specified, the work on developing market network and infrastructures is insufficient, farmer's access on government extension services is very weak (only 17%), all these resulted lower rate of food Self Sufficiency Ratio (SSR) in Nepal and Gorkha (FAO, 2003; Singh, 2008; MoALD, 2019). This is very serious in northern Gorkha. There are per capita food recommendations in different countries in the world. Indian Council of Medical research (ICMR, 1985) in India and World health Organization (WHO, 1986) in the global level recommended the per capita food requirement (Table-2). The recommendation can be taken as the reference for the food requirement in Gorkha too.

Table-2: Per capita food recommendation, ICMR 1985 (gm/person)

Food group	Daily(gm/day/person)			Yearly(kg/year/ person)		
	Minimum	Maximum	Average	Minimum	Maximum	Average
Cereals	400	650	525	146	219	183 (WHO-186)
Pulses	55	80	67.5	20	32	26
Green vegetables	100	125	112.5	37	46	41
Tuber and roots	75	100	87.5	27	37	32
Other vegetables	75	100	87.5	27	37	32
Fruits	30	30	30	11	11	11
Milk	100	200	150	37	73	55
Meat and fish	30	30	30	11	11	11
Eggs	30	30	30	11	11	11
Sugar and honey	30	55	42.5	11	20	16
Fat and oils	35	50	42.5	13	18	16
Total	960	1450	1205	350	514	432

Methodology

Relevant literatures and available data were reviewed. Cultivated and cropped areas, livestock population and gross crop production in Gorkha were collected from Agriculture Knowledge Centre (AKC) Gorkha and the data on animal production from Ministry of Agriculture and Livestock Development (MoALD, 2073/074). Milling return of cereals, pulses, vegetable, potato, fruit, spices, meat, fish, tea/coffee were estimated to be 75%, oilseed 38% and milk, egg, wool, lokta and honey by 100%. Different geography of the district was visited. Farmers field in different rural/municipalities were verified. Interactions were made with the earthquake victims with farming communities in different rural/municipalities in the year 2019. Municipalities' wise quantitative data were segregated and tabulated. Qualitative information collected from interactions and field visit were synthesized and result were presented.

Results and discussion

Total population of Gorkha is 271061 (AKC Gorkha, 2019). Gorkha produces sufficient milled cereals, table fruits and spices (24631.6, 503.4 and 1429.1 MT/year) to feed the population. However, the district is seriously deficit on milled pulses, table vegetable,

potato/tubers, meat fish and milk production (3732.6, 8533.9, 8119.6, 2047.4, 2955.7 and 7295.6 MT/year). Eggs are also in deficit by 8453900 pieces/year. Gorkha does not produce sugar and oil/fat production is also minimal. The deficit of sugar and oil/fat is about 4337.0 and 4011.5MT/year respectively. There is an ample possibility to be self sufficient on potato, vegetable and milk having higher SSR (70.4, 70.0 and 68.5% respectively). Pulses meat and eggs are other commodities can hold self sufficiency with hard efforts. Detail of the food production, food requirement, food balance and the Self Sufficiency Ratio (SSR) and Import Dependency Ratio (IDR) is given in Table-3 below.

Table-3: Food/fiber production, requirement and balance in Gandaki, 2019

S N	Commodity	Per capita food (mt/yr)	Area/Head Nos*	Gross food production (mt/yr) *	Milled food production (mt/yr)	Food requirement (mt/yr)	Food balance (mt/yr)	SSR (%)	IDR (%)
1	Cereals	183	48212	98981	74235.8	49604.2	24631.6	149.7	00
2	Pulses	26	2310	4420	3315.0	7047.6	-3732.6	47.0	53.0
3	Vegetables	100	2456.5	24763	18572.3	27106.1	-8533.9	68.5	31.5
4	Potato/tubers	100	2504	25315.4	18986.6	27106.1	-8119.6	70.0	30.0
5	Fruits	30	1437.5	11513.7	8635.3	8131.8	503.4	106.2	00
6	Spices	3	382	2989.7	2242.3	813.2	1429.1	275.7	00
7	Sugar	16	0	0	0.0	4337.0	-4337.0	0.0	100.0
8	Oilseed/Ghee	16	865	856.5	325.5	4337.0	-4011.5	7.5	92.5
9	Honey	0.5	11609	9.85	9.9	135.5	-125.7	7.3	92.7
10	Tea	NA	2	1	0.8	NA	NA	Na	Na
11	Coffee	NA	20	84	63.0	NA	NA	Na	Na
12	Meat	14	-	2330	1747.5	3794.9	-2047.4	46.0	54.0
13	Fish	11	17.38	34.6	26.0	2981.7	-2955.7	0.9	99.1
14	Milk Catt, Buff	91	154453	17371	17371	24666.6	-7295.6	70.4	29.6
15	Eggs (000)	48	456245	4557	4557	13010.9	-8453.9	35.0	65.0
16	Wool	NA	30280	22.1	22.1	NA	NA	Na	Na
17	Lokta	NA	NA	1.855	1.855	NA	NA	Na	Na

*source: AKC Gorkha, 2019

The geographic diversity permits feasibility of commercialize production in economic scale of different agriculture commodities in different municipalities as following:

1. Chun Numbri Rural Municipality

Chun Numbri is north most high hill municipality in Gorkha. The population of this rural municipality is 7417. The gross and milled cereals and pulses production in Chun Numbri seems seriously deficit by 101.1 and 30.3MT/year. Fruits, sugar, oil/fat, fish, honey, milk and eggs are also deficit. However Chun Numbri is self sufficient on meat, potato, vegetable and species (Table-4).

High hill potato/potato seed production in Chun Numbri seems most feasible for the livelihood recovery and economic resilience. Potato is a stable crop. Local black potato is unique in taste and color. However the improved varieties from outside the municipality are replacing the unique and valuable potato variety. The local seed potato can be store in room condition and do not necessary to have the cold storage here. However, identification of the geography and users group/s, training and capacity building, establish facilities for TPS/PBS production, construction of community storage and input management (seeds, irrigation, storage, organic manure, soft loan, technology, transportation, etc.) are the pre-requisites. Alternatively, cultivation of medicinal herbs, blocked with neighboring Dharche rural municipality is the solution. In addition, decides fruits, trout fish and ground apple production

Table-4: Food/fiber production, requirement and balance in Chun Numbri, 2019

SN	Commodity	Per capita food (mt/yr)	Gross food/ fiber production* (mt/yr)	Milled food /fiber production (mt/yr)	Food requirement (mt/yr)	Food balance (mt/yr)
1	Cereals	183	1675	1256.3	1357.3	-101.1
2	Pulses	26	216.6	162.5	192.8	-30.3
3	Vegetables	100	1012	759.0	741.7	17.3
4	Potato/tubers	100	2639	1979.3	741.7	1237.6
5	Fruits	30	103.2	77.4	222.5	-145.1
6	Spices	3	59.5	44.6	22.3	22.3
7	Sugar	16	0	0.0	118.7	-118.7
8	Oilseed/Ghee	16	0	0.0	118.7	-118.7
9	Honey	0.5	0	0.0	3.7	-3.7
10	Tea	NA	0	0.0	NA	NA
11	Coffee	NA	0	0.0	NA	NA
12	Meat	14	204	153.0	103.8	49.2
13	Fish	11	0	0.0	81.6	-81.6
14	Milk (Catt, Buff)	91	172	172	674.9	-502.9
15	Eggs (000)	48	302	302	356	-54.0
16	Wool	NA	7.8	7.8	NA	NA
17	Lokta	NA	0.465	0.465	NA	NA

*source: AKC Gorkha, 2019

shall be tie up with agro-tourism. The local black potato shall remain as staple; can explore the market of tubers, seed potato and potato seeds and the geographically indicated (GI) niche product and promote agro-tourism for livelihood recovery and the seed potato and potato products will be the products for income generation and economic resilience of earthquake victims in Chun Numbri.

2. Dharche Rural Municipality

Dharche is also a high hill municipality in Gorkha. The population of this rural municipality is 13264. The gross and milled pulses, table vegetable and fruits production in Dharche seems seriously deficit by 231.7, 1128.4 and 339.4MT/year. Sugar, oil/fat and fish are not producing here. However Dharche is in balance and self sufficient on cereals, potato, spices, meat and milk production (Table-5).

Dharche rural municipality is also geographically in high hills of Gorkha. Medicinal herbs production is already initiated here and seems most feasible and profitable enterprise. Medicinal herbs are most high value, saleable crops. Harvested materials can be store in room condition. Darche is going to be connected with road transportation. For the commercialization of medicinal herbs, it needs to identify the geography and users group/s, training and capacity building, establishment of high tech facilities for the production of planting material and medicinal herbs, construction of community storage house/s and input management (seeds/saplings, irrigation, storage, organic manure, soft loan, technology, transportation, etc.). Alternative activity can be high hill potato/potato seed production blocked with Chun Numbri and Barpak Sulikot rural municipalities. Decides fruits, trout fish, ground apple, vegetables and vegetable seeds production shall be tie up with agro-tourism in addition to medicinal herbs for the economic resilience of the earthquake victims. All these can sufficiently generate the employment and income of the people in Dharche.

Table-5: Food/fiber production, requirement and balance in Dharche, 2019

SN	Commodity	Per capita food (mt/yr)	Gross food/fiber production (mt/yr) *	Milled food/fiber production (mt/yr)	Food requirement (mt/yr)	Food balance (mt/yr)
1	Cereals	183	49105	3682.5	2427.3	1255.2
2	Pulses	26	151	113.3	344.9	-231.7
3	Vegetables	100	264	198.0	1326.4	-1128.4
4	Potato/tubers	100	2022	1516.5	1326.4	190.1
5	Fruits	30	78	58.5	397.9	-339.4
6	Spices	3	355	266.3	39.8	226.5
7	Sugar	16	0	0.0	212.2	-212.2
8	Oilseed/Ghee	16	0	0.0	212.2	-212.2
9	Honey	0.5	0	0.0	6.6	-6.6
10	Tea	NA	0	0.0	NA	NA
11	Coffee	NA	0	0.0	NA	NA
12	Meat	14	361.5	271.1	185.7	85.4
13	Fish	11	0	0.0	145.9	-145.9
14	Milk (Catt, Buff)	91	1284	1284	1207	77.0
15	Eggs (000)	48	355	355	636.7	-281.7
16	Wool	NA	7	7	NA	NA
17	Lokta	NA	0.54	0.54	NA	NA

*source: AKC Gorkha, 2019

3. Barpak Sulikot Rural Municipality

Barpak Sulikot is also a high hill municipality in Gorkha. It was the epicenter of Barpak earthquake, 2015. The population of this rural municipality is 25399. The gross and milled pulses, table vegetable, potato and fruits production in Barpak Sulikot seems seriously deficit by 543.4, 1071.4, 2085.0 and 524.1MT/year. Meat, milk, oil/fat and eggs are also deficit in a considerable volume. Sugar is not producing here. However, Barpak Sulikot is in balance and self sufficient on cereals and spices production (Table-6).

Table-6: Food/fiber production, requirement and balance in Barpak Sulikot, 2019

SN	Commodity	Per capita food (mt/yr)	Gross food production (mt/yr) *	Milled food production (mt/yr)	Food requirement (mt/yr)	Food balance (mt/yr)
1	Cereals	183	9797	7347.8	4648	2699.8
2	Pulses	26	156	117.0	660.4	-543.4
3	Vegetables	100	1958	1468.5	2539.9	-1071.4
4	Potato/tubers	100	606.6	455.0	2539.9	-2085.0
5	Fruits	30	317.2	237.9	762	-524.1
6	Spices	3	331.8	248.9	76.2	172.7
7	Sugar	16	0	0.0	406.4	-406.4
8	Oilseed/Ghee	16	14.85	5.6	406.4	-400.8
9	Honey	0.5	0.6	0.5	12.7	-12.3
10	Tea	NA	0	0.0	NA	NA
11	Coffee	NA	6	4.5	NA	NA
12	Meat	14	223	223	355.6	-132.6
13	Fish	11	NA	NA	279.4	NA
14	Milk (Catt, Buff)	91	986	986	2311.3	-1325.3
15	Eggs (000)	48	457	457	1219.2	-762.2
16	Wool	NA	2.5	2.5	NA	NA
17	Lokta	NA	0.75	0.75	NA	NA

*source: AKC Gorkha, 2019

Hill maize/maize seed production is most suitable business in Barpak Sulikot for commercialization, livelihood recovery and economic resilience. Demand of maize seed in mid hill is increasing rapidly. Maize grains can be used both on food and feed. Barpak Sulikot is recently road connected. For the commercialization of hill maize/maize seed, identification of the geography and users group/s, training and capacity building on production and post harvest operations, establish maize grit and feed industries, construction of community seed storage house/s provision with seed processing, packing and input management (seeds, irrigation, storage, organic manure, soft loan, technology, transportation, etc.) are the pre-requisites. Alternative activity can be high hill potato/potato seed production blocked with Dharche and Chun Numbri. However, goat production, white sandal and timur cultivation, cerana beekeeping and kiwi production shall be blocked with Siranchok and Ajirkot and tie up with agro-tourism. This program can enhanced local food and nutrition security, employment and income generated from maize seed supply and will link maize and maize seed production and other supportive programs on tourism also.

4. Ajirkot Rural Municipality

Ajirkot is also a high hill municipality in Gorkha located near the epicenter of Barpak earthquake, 2015. It is recently road connected. The population of this rural municipality is 15602. The gross and table vegetable, potato and fruits production in Ajirkot seems seriously deficit by 603.2, 165.1 and 378.7MT/year. Meat and eggs are also in deficit. Ajirkot do not produce sugar and oilseed in a considerable volume. However, Ajirkot is in balance and self sufficient on cereals, pulses, spices and milk production (Table-7).

Table-7: Food/fiber production, requirement and balance in Ajirkot, 2019

SN	Commodity	Per capita food (mt/yr)	Gross food production (mt/yr) *	Milled food production (mt/yr)	Food requirement (mt/yr)	Food balance (mt/yr)
1	Cereals	183	11807	8855.3	2855.2	6000.1
2	Pulses	26	834	625.5	405.7	219.8
3	Vegetables	100	1276	957.0	1560.2	-603.2
4	Potato/tubers	100	1860.2	1395.2	1560.2	-165.1
5	Fruits	30	119.14	89.4	468.1	-378.7
6	Spices	3	418.7	314.0	46.8	267.2
7	Sugar	16	0	0.0	249.6	-249.6
8	Oilseed/Ghee	16	26.73	10.2	249.6	-239.4
9	Honey	0.5	3	2.3	7.8	-5.6
10	Tea	NA	1	0.8	NA	NA
11	Coffee	NA	48	36.0	NA	NA
12	Meat	14	253	189.8	218.4	-28.7
13	Fish	11	NA	NA	171.6	NA
14	Milk (Catt, Buff)	91	2098	2098	1419.8	678.2
15	Eggs (000)	48	482	482	748.9	-266.9
16	Wool	NA	2.8	2.8	NA	NA
17	Lokta	NA	0.1	0.1	NA	NA

*source: AKC Gorkha, 2019

Timur, white sandal and utis (*Alnus nepalensis* D. Don. Betulaceae) based agro-forestry with the plantation crops like cardamom, tea and coffee production are the most feasible commodities for the commercial production in Ajirkot. Chepekhola water shade area of Ajirkot is already commercializing on cardamom, tea and coffee production. GI indicated organic market of these plantation crops and the product of timer, timur and the sandal wood are sound with high value. Fodder and deciduous fruits also are feasible. However,

identification of the geography and users group/s, establishment of high tech bio-safe tissue culture lab, nurseries and resource centre for quality sapling production of timur, white sandal, utis, cardamom, tea, coffee, fodder and decides fruits together with training and capacity building on production and post harvest operations, establishment of drying, processing, packaging and storage units for timur, sandal wood, cardamom, tea and coffee processing, input management (saplings, irrigation, storage, organic manure, soft loan, technology, transportation, etc.) are very important for it. Goat production, kiwi, decides fruits, trout production, etc., can be the alternative activities providing additional income. This can generate employment and income from timer, sandal wood, cardamom, tea, coffee, goat, trout fish and decides fruits production and also can link on tourism for additional income.

5. Siranchok Rural Municipality

Siranchok is a mid hill rural municipality in south-west Gorkha near the epicenter of Barpak earthquake, 2015. Siranchok is connected by all weather black topped road. The population of this rural municipality is 23666. The milled pulses, table vegetable, fruits and meat production in Siranchok seems seriously deficit by 430.8, 1891.9, 551.3 and 178.3MT/year. Eggs are also in deficit by 723000 pices/year. Honey and milk are about to self sufficiency. Siranchok do not produce sugar, and the production of oil/fat is minimal. However, Siranchok is in balance and self sufficient on cereals, potato and spices production (3424.9, 430.8 and 266.7MT/year respectively) (Table-8).

Table-8: Food/fiber production, requirement and balance in Siranchok, 2019

SN	Commodity	Per capita food (mt/yr)	Gross food production (mt/yr) *	Milled food production (mt/yr)	Food requirement (mt/yr)	Food balance (mt/yr)
1	Cereals	183	10341	7755.8	4330.9	3424.9
2	Pulses	26	246	184.5	615.3	-430.8
3	Vegetables	100	633	474.8	2366.6	-1891.9
4	Potato/tubers	100	3285.8	2464.4	2366.6	97.8
5	Fruits	30	211.54	158.7	710	-551.3
6	Spices	3	450.3	337.7	71	266.7
7	Sugar	16	0	0.0	378.7	-378.7
8	Oilseed/Ghee	16	49.5	18.8	378.7	-359.9
9	Honey	0.5	0.5	0.4	11.8	-11.4
10	Tea	NA	0.5	0.4	NA	NA
11	Coffee	NA	10	7.5	NA	NA
12	Meat	14	204	153.0	331.3	-178.3
13	Fish	11	NA	NA	260.3	NA
14	Milk (Catt, Buff)	91	2082	2082	2153.6	-71.6
15	Eggs (000)	48	413	413	1136	-723.0
16	Wool	NA	1	1	NA	NA
17	Lokta	NA	0	0	NA	NA

*source: AKC Gorkha, 2019

Goat production seems most appropriate business in Siranchok because of having sufficient forest areas, agro-forestry and fodder availability. Goat meat has good market demand and importing commodity in Nepal. Dairy goat is another demanding business. NARC Bandipur farm is accessible for supporting breeding and breed improvement. For the commercial goat production in Siranchok, it needs to further identify the geography and users group/s, establish high tech breeding centre/resource centre for quality breeding stock production, establish fodder nurseries, fodder tree planting, forage seed production and pasture management.

Training and capacity building on husbandry management, input management (goat shades, drinking water, feed, soft loan, technology, transportation, health care and veterinary services, etc.) and establishment of organic manure factory with goat manure are also equally important. Alternatively rice/rice seed (Daraudi-Bhusunde) production, *cerana* beekeeping, cardamom/ tea/coffee, kiwi, hill maize/maize seed production shall be tie up with agro-tourism for the additional income. The expected result can be enhanced local food and nutrition security, employment and income generation from goat kids, meat, milk and manure production and linking *cerana* beekeeping, cardamom/tea/coffee, kiwi and hill maize/maize seed production with tourism for additional income, livelihood recovery and economic resilience of the earthquake victims in Siranchok.

6. Arughat Rural Municipality

Arughat is a mid hill rural municipality in south-east Gorkha. It is connected with road transportation. The population of this rural municipality is 23915. Arughat is seriously deficit on milled pulses, table vegetable, fruits meat and milk production (438.8, 2031.5, 576.5, 192.3 and 315.3MT/year. Eggs are also in deficit by 726900pices/year. Arughat do not produce sugar and oil/fat production is minimal. However, Arughat is in balance and self sufficient on cereals, potato and spices production (5946.6, 2158and 194.9MT/year respectively) (Table-9).

Table-9: Food/fiber production, requirement and balance in Arughat, 2019

SN	Commodity	Per capita food (mt/yr)	Gross food production (mt/yr)	Milled food production (mt/yr)	Food requirement (mt/yr)	Food balance (mt/yr)
1	Cereals	183	13764	10323	4376.4	5946.6
2	Pulses	26	244	183	621.8	-438.8
3	Vegetables	100	480	360	2391.5	-2031.5
4	Potato/tubers	100	6066	4549.5	2391.5	2158
5	Fruits	30	187.95	141.0	717.5	-576.5
6	Spices	3	355.5	266.6	71.7	194.9
7	Sugar	16	0	0	382.6	-382.6
8	Oilseed/Ghee	16	24.75	9.4	382.6	-373.2
9	Honey	0.5	0.25	0.2	12	-11.8
10	Tea	NA	0	0	NA	NA
11	Coffee	NA	6	4.5	NA	NA
12	Meat	14	190	142.5	334.8	-192.3
13	Fish	11	NA	NA	263.1	NA
14	Milk (Catt, Buff)	91	1861	1861	2176.3	-315.3
15	Eggs (000)	48	421	421	1147.9	-726.9
16	Wool	NA	1	1	NA	NA
17	Lokta	NA	0	0	NA	NA

*source: AKC Gorkha, 2019

Similar to Siranchok, Arughat is also highly feasible for commercial goat farming because of having sufficient forest areas, agro-forestry and fodder availability. Goat meat has good market demand and importing commodity in Nepal. Dairy goat is another demanding business. NARC Bandipur farm is accessible for supporting breeding and breed improvement Arughat is road connected area. However, for the commercial goat production it needs to identify the geography and users group/s, establishment of high tech breeding centre/ resource centre for quality breeding stock production, establishment of the fodder nurseries, forage seed production, fodder tree planting and pasture management. Training and capacity building on husbandry management, input management (goat shades, drinking water, feed,

soft loan, technology, transportation, health care and veterinary services, etc.) and establishment of organic manure factory with goat manure are also necessary. Hill maize/maize seed production, blocking with Barpak Sulikot can be the alternative activity to goat farming. Cardamom/coffee, organic vegetable production shall be tie up with agro-tourism for the additional income. This can enhance local food and nutrition security, generate employment and income from goat kids, meat, milk and manure, can link goat farming and dairy goat on tourism. Hill maize/maize seed, cardamom/coffee, organic vegetable production can also support for agro-tourism, livelihood recovery and economic resilience of the earthquake victims.

7. Bhimsen Rural Municipality

Bhimsen is a mid hill rural municipality in south-east Gorkha, connected by a black top, all weather road. The population of this rural municipality is 22053. Bhimsen is seriously deficit on milled cereals, pulses, table potato, fruits, and meat and milk production (660.7, 467.7, 1902.0, 603.2, 182.0 and 1126.8MT/year. Eggs are also in deficit by 655500 pices/year. Bhimsen do not produce sugar and oil/fat production is minimal. However, Bhimsen is in balance and self sufficient on table vegetable and spices production (228.5 and 70.1 MT/year respectively) (Table-10).

Table-10: Food/fiber production, requirement and balance in Bhimsen, 2019

SN	Commodity	Per capita food (mt/yr)	Gross food production (mt/yr)*	Milled food production (mt/yr)	Food requirement (mt/yr)	Food balance (mt/yr)
1	Cereals	183	4500	3375	4035.7	-660.7
2	Pulses	26	141	105.75	573.4	-467.7
3	Vegetables	100	3245	2433.75	2205.3	228.5
4	Potato/tubers	100	404.4	303.3	2205.3	-1902.0
5	Fruits	30	77.9	58.425	661.6	-603.2
6	Spices	3	181.7	136.275	66.2	70.1
7	Sugar	16	0	0	352.8	-352.8
8	Oilseed/Ghee	16	176.22	67.0	352.8	-285.8
9	Honey	0.5	0.25	0.25	11	-10.8
10	Tea	NA	0	0	NA	NA
11	Coffee	NA	2	1.5	NA	NA
12	Meat	14	169	126.75	308.7	-182.0
13	Fish	11	NA	NA	242.6	NA
14	Milk (Catt, Buff)	91	880	880	2006.8	-1126.8
15	Eggs (000)	48	403	403	1058.5	-655.5
16	Wool	NA	0	0	NA	NA
17	Lokta	NA	0	0	NA	NA

*source: AKC Gorkha, 2019

Avocado seems one of the major commodities for cultivation in Bhimsen rural municipality. IDR of fruits in Nepal is 88.1% (MoALD, 2017/018) and the market price of avocado currently is about NPR 400/kg, which is one of the major importing fruit in cities. Avocado reserves high nutritional and health value. Bhimsen rural municipality holds about 59% total cultivated areas rain fed and is highly feasible for avocado cultivation. However, for its commercial production, it needs to identify the geography and users group/s, establishment of high tech nurseries/resource centre for quality grafted sapling production, establish avocado orchards and their intensive management, training and capacity building on nursery and orchard management. Improved post harvest operation, input management (saplings, irrigation, manure, soft loan, technology, transportation, plant protection, etc.), establishment of post harvest centre with grading, packaging and processing facilities, market promotion and marketing avocado saplings, fruits and fruit products are equally important. Agro-

forestry with white sandal and coffee, goat production and *cerana* beekeeping shall be the alternative activities to be tie up with agro-tourism for the extra income generation. The program can enhance local food and nutrition security; generate employment and income from avocado production, linked avocado farming on tourism. White sandal, coffee, goat farming and *cerana* beekeeping also can generate additional income to the farmers and can give synergy to agro-tourism.

8. Sahid Lakhan Rural Municipality

Sahid Lakhan is a mid hill rural municipality in south-east Gorkha. It is well connected by road transportation. The population of this rural municipality is 27555. Sahid Lakhan is seriously deficit on milled cereals, pulses, table vegetables and potato/tubers, meat and milk production (1798.9, 632.4, 226.1 and 2414.3, 232.8 and 310.5 MT/year). Eggs are also in deficit by 878600 pieces/year. Sahid Lakhan does not produce sugar and oil/fat production is also minimal. However, Sahid Lakhan is in balance and self sufficient on table fruits and spices production (479.4 and 41.7MT/year respectively) (Table-11).

Table-11: Food/fiber production, requirement and balance in Sahid Lakhan, 2019

SN	Commodity	Per capita food (mt/yr)	Gross food production (mt/yr)*	Milled food production (mt/yr)	Food requirement (mt/yr)	Food balance (mt/yr)
1	Cereals	183	432.5	3243.8	5042.6	-1798.9
2	Pulses	26	112	84.0	716.4	-632.4
3	Vegetables	100	3372.5	2529.4	2755.5	-226.1
4	Potato/tubers	100	455	341.3	2755.5	-2414.3
5	Fruits	30	1741.44	1306.1	826.7	479.4
6	Spices	3	165.9	124.4	82.7	41.7
7	Sugar	16	0	0.0	440.9	-440.9
8	Oilseed/Ghee	16	44.55	16.9	440.9	-424.0
9	Honey	0.5	0.25	0.3	13.8	-13.6
10	Tea	NA	0	0.0	NA	NA
11	Coffee	NA	3	2.3	NA	NA
12	Meat	14	204	153.0	385.8	-232.8
13	Fish	11	NA	NA	303.1	NA
14	Milk (Catt, Buff)	91	2197	2197	2507.5	-310.5
15	Eggs (000)	48	444	444	1322.6	-878.6
16	Wool	NA	0	0	NA	NA
17	Lokta	NA	0	0	NA	NA

*source: AKC Gorkha, 2019

Sahid Lakhan is already declared as citrus production zone by the Prime minister Agriculture Modernization Project. The municipality is highly feasible for the commercialization of citrus fruit because of its geography, soil and the climate. IDR of fruits in Nepal is about 88.1% (MoALD, 2017/018) and the lemon and oranges are most demanded and importing fruit in Nepal. Per capita consumption of fruits in Nepal is very low (17 vs 30 kg/yr). For the commercialization of citrus cultivation in Sahid Lakhan rural municipality it needs to identify the geography and users group/s, establish high tech nurseries/resource centre for quality sapling production (nucellar, grafted, tissue culture..), establishment of citrus (lemon/orange) orchards and their intensive management (one family 10 lemon tree?), training and capacity building on nursery, orchard management and post harvest operation, input management (saplings, irrigation, manure, soft loan, technology, transportation, plant protection, etc.), establishment of post harvest centre with grading, packaging and processing facilities and market promotion. Avocado production blocked with Bhimsen rural municipality can be the

alternative activity together with integration of goat production and *cerana* beekeeping tie up with agro-tourism can give synergy to employment and income generation. These activities will enhanced local food and nutrition security, generate employment and income from citrus production, avocado production, goat farming and *cerana* beekeeping linked with tourism for the livelihood recovery and economic resilience.

9. Gandaki Rural Municipality

Gandaki is a mid hill rural municipality in south-east Gorkha. The sites of Gandaki have road access to major cities of Nepal. The population of this rural municipality is 23262. Gandaki is seriously deficit on milled cereals, pulses, table potato/tubers and meat production (332.9, 495.3, 695.7 and 181.7MT/year). Eggs are also in deficit by 683600 pieces/year. Gandaki does not produce sugar and oil/fat production is also minimal. However, Gandaki is in balance and self sufficient on table vegetables, fruits, spices and milk production (1099.4, 3325.1, 25.0 and 80.2 MT/year respectively) (Table-12).

Table-12: Food/fiber production, requirement and balance in Gandaki, 2019

SN	Commodity	Per capita food (mt/yr)	Gross food production (mt/yr)*	Milled food production (mt/yr)	Food requirement (mt/yr)	Food balance (mt/yr)
1	Cereals	183	5232	3924	4256.9	-332.9
2	Pulses	26	146	109.5	604.8	-495.3
3	Vegetables	100	4567.5	3425.6	2326.2	1099.4
4	Potato/tubers	100	2174	1630.5	2326.2	-695.7
5	Fruits	30	5364	4023.0	697.9	3325.1
6	Spices	3	126.4	94.8	69.8	25.0
7	Sugar	16	0	0	372.2	-372.2
8	Oilseed/Ghee	16	24.75	9.4	372.2	-362.8
9	Honey	0.5	3.5	3.5	11.6	-8.1
10	Tea	NA	0	0	NA	NA
11	Coffee	NA	3	2.3	NA	NA
12	Meat	14	192	144.0	325.7	-181.7
13	Fish	11	NA	NA	255.9	NA
14	Milk (Catt, Buff)	91	2197	2197.0	2116.8	80.2
15	Eggs (000)	48	433	433.0	1116.6	-683.6
16	Wool	NA	0	0	NA	NA
17	Lokta	NA	0	0	NA	NA

*source: AKC Gorkha, 2019

Organic vegetable production is found most feasible commodity for the commercialization, livelihood recovery and economic resilience for the earthquake victims in Gandaki rural municipality. IDR of vegetables in Nepal is about 34.1% (MoALD, 2017/018) and is important commodity to be self sufficient in the country. The demand of organic vegetable in urban areas is rapidly increasing. Organic vegetable can get premium value and that is feasible in Gandaki. Major activities for the commercial production of the organic vegetables covers; identification of the geography and users group/s, establishment of high tech nurseries/resource centre for quality seedling and seed production, establishment of high tech and ordinary organic vegetable production farms, training and capacity building on nursery, farm management and post harvest operation, input management (seeds, irrigation, manure, soft loan, technology, transportation, plant protection, cold chain, etc.), establishment of post harvest centre with grading, packaging and processing facilities and marketing and market promotion. Goat farming shall be the alternative activity however; milk production, citrus cultivation and *cerana* beekeeping shall be tie up with agro-tourism for the additional

income. All this effort can enhance local food and nutrition security; generate employment and income from organic vegetable, goat, milk, citrus production and *cerana* beekeeping and tourism for the livelihood recovery and economic resilience of the earthquake victims in Gandaki rural municipality.

10. Gorkha Municipality

Gorkha municipality is in mid hill of south-west Gorkha. The population is 50684. The municipality is deficit on all the food items except cereals. It is seriously deficit on milled pulses, table vegetables, potato/tubers, fruits, spices, sugar, oilseed/ghee, honey, meat and milk production (792.8, 2504.2, 3938.9, 391.8, 81, 810.9, 698.0, 24.3 and 586.6 MT/year respectively). Eggs are also in deficit by 2643.200 pieces/year. However, Gorkha is in balance and self sufficient on milled cereals production (707.3 MT/year) (Table-13).

Table-13: Food/fiber production, requirement and balance in Gorkha, 2019

SN	Commodity	Per capita food (mt/yr)	Gross food production (mt/yr)*	Milled food production (mt/yr)	Food requirement (mt/yr)	Food balance (mt/yr)
1	Cereals	183	13310	9982.5	9275.2	707.3
2	Pulses	26	700	525.0	1317.8	-792.8
3	Vegetables	100	3419	2564.3	5068.4	-2504.2
4	Potato/tubers	100	1506	1129.5	5068.4	-3938.9
5	Fruits	30	1505	1128.8	1520.5	-391.8
6	Spices	3	94.8	71.1	152.1	-81
7	Sugar	16	0	0	810.9	-810.9
8	Oilseed/Ghee	16	297	112.9	810.9	-698.0
9	Honey	0.5	1	1	25.3	-24.3
10	Tea	NA	0	0	NA	NA
11	Coffee	NA	12	9	NA	NA
12	Meat	14	164	123	709.6	-586.6
13	Fish	11	NA	NA	557.5	NA
14	Milk (Catt, Buff)	91	1969	1969	4612.2	-2643.2
15	Eggs (000)	48	422	422	2432.8	-2010.8
16	Wool	NA	0	0	NA	NA
17	Lokta	NA	0	0	NA	NA

*source: AKC Gorkha, 2019

Organic vegetable production is highly feasible and commercial business in Gorkha municipality. IDR of vegetables in Nepal is about 34.1% (MoALD, 2017/018) and is important commodity to be self sufficient. The demand of organic vegetable in urban areas in Nepal is rapidly increasing and it has premium value. There is road accessibility in Gorkha municipality for vegetable transportation and input supply. Major activities for this can be, identification of the geography and users group/s, establishment of high tech nurseries/resource centre for quality seedling and seed production, establishment of high tech and ordinary organic vegetable production farms, training and capacity building on nursery/farm management and post harvest operation, input management (seeds, irrigation, manure, soft loan, technology, transportation, plant protection, cold chain, etc.), establishment of post harvest centre with collection, grading, packaging and processing facilities and marketing and market promotion. Alternatively, rice/rice seed (Daraudi basin) production blocked with Siranchok can also another commodity to be considered. However, milk production blocking with Palungtar and fish production tie up with agro-tourism shall be for the additional income. All these can help for enhancing local food & nutrition security generate employment and income from organic vegetable production, rice/rice seed, milk and fish and

agro-tourism, for the livelihood recovery and economic resilience of the victims in Gorkha municipality.

11. Palungtar Municipality

Palungtar is a, mid hill municipality located in southwest Gorkha. Which is connected by all season black top road. The population of this municipality is 38244. Palungtar is deficit on table vegetable, potato/tubers, spices, meat and milk production (422.4, 2876.4, 2.1, 410.9 and 1835.2 MT/year respectively). Eggs are also in deficit by 1410700 pieces/year. Palungtar does not produce sugar and oil/fat production is also minimal. However, Palungtar is in balance and self sufficient on milled cereals, pulses and table fruits production (7491.3, 10.7 and 208.8MT/year respectively) (Table-14).

Table-14: Food/fiber production, requirement and balance in Palungtar, 2019

SN	Commodity	Per capita food (mt/yr)	Gross food production (mt/yr)*	Milled food production (mt/yr)	Food requirement (mt/yr)	Food balance (mt/yr)
1	Cereals	183	19320	14490	6998.7	7491.3
2	Pulses	26	1340	1005	994.3	10.7
3	Vegetables	100	4536	3402	3824.4	-422.4
4	Potato/tubers	100	1264	948	3824.4	-2876.4
5	Fruits	30	1808.07	1356.0525	1147.3	208.8
6	Spices	3	150.1	112.575	114.7	-2.1
7	Sugar	16	0	0	611.9	-611.9
8	Oilseed/Ghee	16	198	75.2	611.9	-536.7
9	Honey	0.5	0.5	0.5	19.1	-18.6
10	Tea	NA	0	0	NA	NA
11	Coffee	NA	6	4.5	NA	NA
12	Meat	14	166	124.5	535.4	-410.9
13	Fish	11	NA	NA	420.7	NA
14	Milk (Catt, Buff)	91	1645	1645	3480.2	-1835.2
15	Eggs (000)	48	425	425	1835.7	-1410.7
16	Wool	NA	0	0	NA	NA
17	Lokta	NA	0	0	NA	NA

*source: AKC Gorkha, 2019

Milk production found most feasible commodity for commercialization in Palungtar. IDR of Milk in Nepal is about 21.0% (MoALD, 2017/018) and is important commodity to be self sufficient. The demand of milk in urban areas is increasing by 8%. The major activities shall be, identification of the geography and users group/s for block production, establishment of high tech fodder nurseries/resource centre for quality fodder seedling and forage seed production and develop pasture, establishment of high tech and ordinary buffalo and cattle dairy production farms, training and capacity building on milk production and post harvest operation, input management (breeding stocks, drinking water, soft loan, technology, transportation, husbandry management and veterinary services, milk chilling centre, cattle/buffalo shed, buffalo walling pond, etc.), diversification of milk products for local consumption, establishment of organic manure/vermin-compost factory, vermin-compost production and milk marketing and market promotion and establishment of the buffalo fattening centre and slaughter houses for additional income. Alternative activity can be litchi and dragon fruit cultivation together with minor activities on goat production, rice and citrus production. All these should be tie up with agro-tourism. Selling of milk, organic vegetables, litchi citrus and dragon fruits, goat meat, rice and promotion of agro-tourism can enhance

local food & nutrition security and generate local employment and income for the livelihood recovery and economic resilience in Palungtar municipality.

Conclusion and recommendation

Gorkha is self sufficient with surplus production of cereals by 49.7 %, fruits by 6.2% and spices by 175.7 % on its requirement. However Gorkha seriously deficit on sugar by 100%, fish by 99.1%, oilseed/ghee by 92.5% and honey by 92.7%, moderately deficit on poultry eggs by 65.0%, meat by 54.0%, pulses by 53.0%, vegetables by 31.5%, potato/tubers by 30.0% and milk (Cattle, Buffalo) by 29.6%. Gorkha should have clear cut implementing strategy to maintain local food sufficiency programs on perishable, maintain emergency buffer stock at least 50 % of annual needs on pulses, sugar and oil/fats for food security and commercialization of selected commodities. However, commercial agriculture should have given high priority rather than the food self sufficiency for the prosperous Gorkha. The most appropriate commodities for livelihood recovery, commercialization and economic resilience followed by the alternative activity and supportive activities for agro-tourism promotion in different municipalities are recommended (Table-15)

Table-15: Summary of the municipality specific program for economic resilience in Gorkha, 2019

SN	R/Municipality	Priority I	Priority II	Cross Cutting with agro-tourism
1	Chun Numbri	Highhill potato/p. seed	Medicinal herbs	Decides fruits, Trout, Ground Apple
2	Dharche	Medicinal herbs	High hill potato/potato seed/seed potato	Decides fruits, Trout, Ground Apple, Vegetable seeds
3	Barpak Sulikot	Hill maize/maize seed	High hill potato/potato seed/seed potato	Goat production, White Sandal & Timur, <i>Cerana</i> beekeeping, Kiwi
4	Ajirkot	Timur, white sandal & utis base agro-forestry	Goat, Trout production	Kiwi and Decides fruits.
5	Siranchok,	Goat production	Rice/R seed (Daraudi-Bhusunde)	<i>Cerana</i> beekeeping, Cardamom/Tea/Coffee, Kiwi, Hill maize/maize seed
6	Arughat	Goat production	Hill maize/M. seed	Cardamom/Coffee, Organic vegetable
7	Bhimsen	Avocado	White Sandal/Coffee	Goat production, <i>Cerana</i> beekeeping,
8	Sahid Lakhan	Citrus	Avocado	Goat production, <i>Cerana</i> beekeeping,
9	Gandaki	Organic vegetable	Goat production	Milk Production, Citrus, <i>Cerana</i> beekeeping,
10	Gorkha	Organic vegetable	Daraudi basin rice/rice seed production	Milk production, Fish production
11	Palungtar	Milk production	Litchi & Dragon fruit	Goat production, Rice, Citrus

Economic scale of production is possible from blocking of the production program with neighboring rural/municipalities. However, the program should be back up from establishing service delivery organization with sufficient skilled human resource, agriculture infrastructure support (irrigation, collection centre, market centre, agro-industries, custom hiring centre, farm structures, community ware houses, cold storage/chain, chilling centre, etc), agriculture inputs (fertilizers, manures & soil amendments, seeds, breeds, saplings, equipments, machineries, etc), farmer's welfare scheme (crop and livestock insurance, soft loan scheme, subsidy support, land banking, contract farming and contributory pension scheme), regulation (fertilizer, manure, seed, pesticide, etc) and support services (, subject specific services (disease diagnosis and treatment, soil/seed/pesticide testing, field layout, entrepreneurship development, demonstration, training, etc).

Further steps ahead shall be the field verification and technical assessment, stakeholder's consultation, interaction with users groups, owning from Local Governments, resource matching, local level planning, and implementation of the activities, feedback collection and improvements. For this a clear cut role and responsibility of different stakeholders is expected. The overall responsibility of the Local Government shall be providing financial support: the subsidy support or soft loan support for input management, sapling stocks production, establishment of high tech breeding centre/resource centre for quality breeding stocks, transportation, capacity building, etc; Veterinary Hospital shall take the responsibility of establishing fodder nurseries, forage seed production, fodder tree planting and pasture management, husbandry management and veterinary services, the AKC, CBO and NGO/INGO shall take the responsibility of training and capacity building, knowledge management and providing community and technical support services. NARC shall involve on agriculture research in farmers field on farmers problem. The cooperative and private sector are expected to take the responsibilities on post harvest operation and marketing of the products. They should involve on establishing collection centre (milk, herbs, vegetable, fruits and goat etc), chilling centre, cold chain, slaughter houses and so on. The major role of the user's group shall be group formation/mobilization, geographical identification, and participatory verification of technology, input management and operation of all the activities. A well developed coordination and linkage mechanism should be in place for the integrated mobilization of the resources.

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