Linear Programming for Optimal Diet Decision Problem

Manmohan Patidar, Ramakant Bhardwaj, Sanjay Choudhary

Abstract: ***The aim of the present research paper is to use linear programming to find the Minimize the cost of Human nutrition (vitamins and minerals) to fulfill the daily requirements of age 25-50 years. Model formation using mathematical tools and vitamins, minerals with their resources and their utility in human bodies.***

KEYWORDS: ***Operation research, linear programming, diet decision, minimization,***

I. INTRODUCTION

Operation Research is a new science to provide a window for mathematical optimization and Analysis. The methods of a mathematical model like linear, integer, non-linear, Quadratic, Dynamic and goal programming. Use of mathematical tool linear programming to reduce the expenditures and maximize the profit of a large scale industry. The object of the study is to use Linear programming to allocate minimum cost and maximum fulfill the daily requirements of Vitamins, minerals and Nutritional Requirements, such as vitamin A, group of vitamin B, Vitamin C etc and minerals Calcium (Ca), Magnesium (Mg), Potassium (K) and many more. Vitamins are living nutrients that is necessary for life. Energy in the human body can be achieved through human nutrition, minerals, and vitamins correctly, food which we eat and drink. Vitamins and minerals obtained in our diet come obtained from animal and plant sources. Most of the animal and plant get through the soil vitamins and minerals found in the soil depend on their geographical conditions. The nutrients found in them, depending on plant grew and which nutrients and fertilizers it received. Minerals may be present in the potable water we drink, and this also differs from geographic Situation. For details, one can see in table no.1.1 and 1.2. Fluoride (Fluorine) is the most important mineral fluorine is present in a land, water supplements, plants, and animals. Fluorine is Critical for strong bones and teeth. Just a bit of Fluorine is seen in the human body. Fluorine is not included in our study because it is mostly present in great quantity in nature the principal Sources of fluorine were potable water and food such as cheese, tea, and seafood according to Park K. (2011) reported that, Fluorine is the most Abundant element in Nature, and about 96% Of fluoride in the human body is found in bones and Teeth. Fluorine is essential for the normal mineralization of bones and formation of dental Enamel [1].

II. Model formation Vitamins and minerals

Model examines only necessary justified vitamins and minerals required by the human body at age of 25-50 years. The ingredients examine are Vitamin-A, Vitamin-B1, Vitamin- B2, Vitamin-B3, Vitamin-B5, Vitamin-B6, Vitamin-B7, Vitamin B9, Vitamin B12, Vitamin-C, Vitamin-D, Vitamin-E, Vitamin-K, Choline, and minerals Calcium (Ca), Magnesium(Mg),Phosphorus(P),Potassium(K),Chromium(Cr),Iodine(I),Iron(Fe)Selenium(Se)and Zinc(Zn). The readily usable food considered contain Papaya, Peanuts, Broccoli, Oranges, Tomatoes, Turnip Greens, Barley, Green beans, Carrots, Egg, Cow's Milk (grass-fed) and Chicken. That the vitamins and minerals requirements will be Explicit in Micrograms, milligrams, and Calorie. Summarizes the amount of each vitamin and minerals in foods and their daily Requirement for better health conditions separate, as well as the united price of these Foods. The goal is to minimize the entire food price. The amount of each vitamin and minerals in foods and their daily Requirement for useful haleness state of a separate, as well as the united price of these Foods. The goal is to minimize the entire food price.

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Table No.1.1: Requirements of the nutrition Vitamins and minerals for a Human being.

Vitamins in foods													
	Papaya fresh 276 grams	**Peanuts ,raw 36.50g**	**Broccoli, chopped 156 grams**	**Oranges , fresh 1medium 131 grams**	**Tomatoes ,sliced, raw 180 grams**	**Turnip Greens 144 grams**	**Barley, hulled ,dry 61.33 grams**	**Green beans 125 grams**	**Carrots, Sliced ,raw 122 grams**	**Egg per 100g**	**Cow's Milk, grass-fed 122 grams**	**Chicken, 113.40 grams**	**Requirement Daily**
Vitamin A	**131.10** mcg	**0.00** mcg	**120.74** mcg	**14.74** mcg	**74.97** mcg	**549.34** mcg	**0.67** mcg	**43.75** mcg	**1019.07** mcg	**149** mcg	**56.12** mcg	**6.80** mcg	**850** mcg
Group of Vitamin B													
Vitamin B1 Thiamin	0.06 mg	0.23 mg	0.10 mg	0.11 mg	0.07 mg	0.06 mg	0.40 mg	0.09 mg	0.08 mg	0.06 mg	0.06 mg	0.08 mg	1.3 mg
Vitamin B2 Riboflavin	0.07 mg	0.05 mg	0.19 mg	0.05 mg	0.03 mg	0.10 mg	0.17 mg	0.12 mg	0.07 mg	1.1 mg	0.21 mg	0.13 mg	1.6 mg
Vitamin B3 Niacin	0.99 mg	4.40 mg	0.86 mg	0.37 mg	1.07 mg	0.59 mg	2.82 mg	0.77 mg	1.20 mg	4.0 mg	0.11 mg	15.55 mg	18 mg
Vitamin B5 Pantothenic acid	0.53 mg	0.64 mg	0.96 mg	0.33 mg	0.16 mg	0.39 mg	0.17 mg	0.09 mg	0.33 mg	1.4 mg	0.46 mg	1.090 mg	5.0 mg
Vitamin B6 Pyridoxine	0.10 mg	0.13 mg	0.31 mg	0.08 mg	0.14 mg	0.26 mg	0.20 mg	0.07 mg	0.17 mg	0.04 mg	0.04 mg	0.68 mg	2 mg
Vitamin B7 Biotin	0.00 mcg	6.40 mcg	0.00 mcg	1.31 mcg	7.20 mcg	0.58 mcg	1.27 mcg	1.00 mcg	6.10 mcg	16 mcg	2.32 mcg	0.00 mcg	25 mcg
Vitamin B9 Folate	102.12 mcg	87.60 mcg	168.42 mcg	39.30 mcg	27 mcg	169.92 mcg	23.3 mcg	86.78 mcg	23.18 mcg	44 mcg	6.10 mcg	4.54 mcg	500 mcg
Vitamin B12 Cobalamin	0.00 mcg	0.00 mcg	0.00 mcg	0.00 mcg	0.00 mcg	0.00 mcg	0.00 mcg	0.00 mcg	0.00 mcg	1.5 mcg	0.55 mcg	0.39 mcg	2 mcg
Vitamin C	168.08 mg	0.00 mg	101.24 mg	69.69 mg	24.66 mg	39.46 mg	0.00 mg	12.13 mg	7.20 mg	0 mg	0.00 mg	0.00 mg	80 mg
Vitamin D	0.00 mcg	0.00 mcg	0.00 mcg	0.00 mcg	0.00 mcg	0.00 mcg	0.00 mcg	0.00 mcg	0.00 mcg	1.5 mcg	1.59 mcg	0.11 mcg	10 mcg
Vitamin E	0.83 mg	3.04 mg	2.26 mg	0.24 mg	0.97 mg	2.71 mg	0.35 mg	0.56 mg	0.81 mg	1.6 mg	0.13 mg	0.31 mg	15 mg
Vitamin K	7.18 mcg	0.00 mcg	220.12 mcg	0.00 mcg	14.22 mcg	529.34 mcg	1.35 mcg	20.00 mcg	16.10 mcg	0.30 mcg	0.37 mcg	0.34 mcg	135 mcg
Choline	16.84 mg	19.16 mg	62.56 mg	11 mg	12.06 mg	0.43 mg	23.65 mg	21.13 mg	10.74 mg	285 mg	17.45 mg	96.73 mg	550 mg
Minerals in foods													
Calcium (Ca)	55.20 mg	33.58 mg	62.40 mg	52.40 mg	18.00 mg	197.28 mg	20.24 mg	55.00 mg	40.26 mg	51 mg	137.86mg	17 Mg	1000 mg
Magnesium (Mg)	57.9 mg	61.32 mg	32.76 mg	13.10 mg	19.80 mg	31.68 mg	81.57 mg	22.50 mg	14.64 mg	10 mg	12.20 mg	32.89 Mg	350 mg
Phosphorus (P)	27.60 mg	137.24 mg	104.52 mg	18.34 mg	43.20 mg	41.76 mg	161.92mg	36.25mg	42.70 mg	190 mg	102.48mg	258.55 Mg	700 mg
Potassium (K)	502.32 mg	257.32 mg	457.08 mg	237.11 mg	426.60 mg	292.32 mg	277.23mg	182.5mg	390.4 mg	140 mg	161.04mg	290.3 Mg	4500 mg
Chromium (Cr)	0.00 mcg	0.00 mcg	18.55 mcg	0.39 mcg	1.26 mcg	0.00 mcg	8.16 mcg	2.04 mcg	0.49 mcg	0.40 mcg	0.06 mcg	0.67 mcg	35 mcg
Copper (Cu)	0.12 mg	0.42 mg	0.10 mg	0.06 mg	0.11 mg	0.36 mg	0.31 mg	0.07 mg	0.05 mg	0.02 mg	0.03 mg	0.06 Mg	2 mg
Iodine (I)	0.00 mcg	7.30 mcg	3.12 mcg	0.00 mcg	0.00 mcg	0.00 mcg	4.40 mcg	0.00 mcg	0.00 mcg	45 mcg	28.06 mcg	0.00 mcg	150 mcg

Iron (Fe)	0.69 mg	1.67 mg	1.05 mg	0.13 mg	0.49 mg	1.15 mg	2.21 mg	0.81 mg	0.37 mg	1.7 mg	0.04 mg	1.18 Mg	15 mg
Selenium (Se)	1.66 mcg	2.63 mcg	2.50 mcg	0.65 mcg	0.00 mcg	1.30 mcg	23.12 mcg	0.25 mcg	0.12 mcg	23 mcg	4.51 mcg	31.30 mcg	45 mcg
Zinc (Zn)	0.22 mg	1.19 mg	0.70 mg	0.09 mg	0.31 mg	0.00 mg	1.70 mg	0.31 mg	0.29 mg	1.0 mg	0.45mg	1.13 Mg	15 mg
Calorie	119	207	55	62	32	29	217	44	50	156	74	187	2500 **calorie**
Cost in Rs.	**7**	**5**	**20**	**5**	**2**	**5.50**	**1.5**	**10**	**3**	**4.5**	**5**	**12**	**Minimization**

Table No 1.2: Details of vitamins, minerals with their resources and their utility In human bodies.

Vitamins	**Daily Requirements**	**Primary Natural sources**		**Functions**	**Problems**
		Products Fruit/Vegetable	**Products Animal**		
Vitamin-A CAROTENOIDS /RETINOL Investigated in the years: 1913	More than 850Micrograms (Mcg)	Carrots ,Melon ,Spinach|	By-products of milk, yolk of egg, Liver	Vitamin-A act a middle party in our Eyes, epidemic, genes, effect, protected system, It is essential during the timely level of pregnancy to protect the underdeveloped embryo.	approximately ninety percent of vitamin-A exists in the liver, Vision problems in night.
Vitamin-B1 THIAMIN Investigated in the years:1897	More than 1.3Milli Grams (mg)	Types of all Grain, almonds, Mixed Nuts and Fruit.	Offal, Fish, Meat.	Thiamin plays an essential role in nerve and muscle energy, Energy metabolism, Thiamin is sulfur-include vitamin that participating in strength metabolism, transform carbohydrates.	Muscular weakness, enlarged heart.
Vitamin-B2 RIBOFLAVIN Investigated in the years: 1922	More than 1.6 milligrams (mg)	Types of all Grain, vegetables Green leafy, soybeans yeast and almonds.	Egg, By-products of milk, Meat.	Vision, effect and reproduction of an Energy metabolism, Vitamin B2 plays a role in clear vision, Vitamin-B2 acts a role in clear vision. Participating in oxidation-decrease reactions.	Dermatitis, blurred Vision, growth failure
Vitamin-B3 NIACIN Investigated in the years: 1937	More than 18 milligrams (mg)	Types of all Grain cereals, Nuts, Avocados, sunflower seeds, and peanuts.	Milk, Eggs, Fish, Meat	Neurological processes, Energy metabolism	Pellagra, diarrhea, Blurred vision, Mental disorders.
Vitamin-B5 PANTOTHENIC- ACID Investigated in the years: 1931	More than 5 Milligrams (mg).	Tomato, Mushroom , Broccoli.	Milk, Meat, Fish.	Blood profile wound healing skins and crest.	(Rare) Abdominal pain, vomiting, insomnia.
Vitamin-B6 PYRIDOXINE Investigated in the years: 1934	More than 2milligrams (mg).	Mixed Nuts, gram seed, Indian corn, Banana.	Seafood Fish, non-vegetarian items Chicken, and Liver.	blood structure, DNA (Deoxyribonucleic acid), Nerve activity.	Muscular weakness.
Vitamin-B7 BIOTIN Investigated in the years: 1931	More than 25Micro Grams (Mcg).	Peanuts, Vegetables , Nuts.	Egg, By-products of milk, non-vegetarian item Liver.	Skin, Hair, nails.	(Rare) Confusion, muscle pain, dermatitis, hair loss.

Vitamin-B9 FOLIC-ACID (FOLATE) Investigated in the years: 1941	More than 500 Micrograms (Mcg).	Peanuts, Oranges, Beans, Leafy vegetables, broccoli.	By-products of milk, yolk of egg, Liver.	DNA synthesis.	Megaloblastic anemia, spina bifida.
Vitamin-B12 COBALAMIN Investigated in the years: 1926	More than 2Micro Grams (Mcg).	By-products of milk.	Fish, Liver, Meat, Shellfish.	Nerve energy.	Pernicious anemia.
Vitamin-C ASCORBIC-ACID Investigated in the years: 1926	More than 80milli Grams (mg).	Tomato, vegetables Green leafy, Citrus Fruits.	By-products of milk, Liver.	Immune system, antioxidant, iron absorption, protection against infections.	Kidney stones, infections.
Vitamin-D CALCIFEROL Investigated in the years: 1922	More than 10 Micrograms (Mcg).	Mushrooms, With the support of ultraviolet rays (sunlight) Vitamin-D Produced by the human body.	Yolk of egg, Fish Oily.	Kidneys, intestine, bones, formed in (Skin).	Vitamin-D imperfection creates weakness in human bones.
Vitamins-E ALPHA-TOCOPHEROL Investigated in the years: 1922	More than 15 Milligrams (mg).	Oils of Vegetable, Fruits, vegetable green Leaves, nuts.	By-products of milk, Egg.	Cells of Blood, vitamin-E stored in the liver, Antioxidant.	Diarrhea, nausea, headaches, muscle weakness.
Vitamins-K PHYLLOQUINONES Investigated in the years: 1929	More than 135 Micrograms (Mcg)	Vegetable green Leaves, cauliflower, Oils of Vegetable	By-products of milk, non-vegetarian item Liver, Meat.	Blood (clotting)	Can interfere With anticoagulant medication.
Choline Investigated in the years: 1862	More than 550 milligrams (mg)	Peanuts	Eggs	Gene expression, nerve activity, It is needed for neurotransmitter synthesis	Strictly speaking, Choline is not a vitamin, but an existent nutritious that is often sorted under the B-vitamins, too much quantity liver damage.
Calorie	More than 2500	Papaya, Peanuts ,Broccoli, Oranges ,Tomatoes , Turnip Greens, Barley, Green bean, Carrots.	Egg, Cow's, Milk Chicken	Contained within food, and used by the human body to maintain daily health and life.	More quantity increases the risk for human health.
Minerals	**Daily Requirements**	**Primary Natural sources**		**Functions**	**Use in the body and Risks.**
		Products Fruit/Vegetable	**Products Animal**		

Calcium (Ca) Atomic number: 20 Group 2: LAND MATERIAL ALKALINE Investigated in the years: 1808	More Than 1000 Milligrams (mg)	Green leafy vegetables	By-products of milk, Fish.	Bones and teeth.	Calcium is the amplest mineral in the body. Almost 99% stored in human teeth and bones. Calcium is essential at all stages of life, Calcium is important during pregnancy and also support to control blood pressure.
Magnesium (Mg) Atomic number: 12 Group 2: ALKALINE EARTH METAL Investigated in the years: 1755	More than 350 milligrams (mg)	Vegetables Having dark Green colored Leaves, Mixed Nuts, Types Of all Grain.	Seafood	Efficiency metabolism**,** Bones.	More than partial the person's magnesium is found in the bones, where it acts as an essential part in the growth and support of bones, Magnesium poisonousness is scarce.
Phosphorus (P) Atomic number: 15 Group 15: POLYATOMIC NON-METAL Investigated in the years: 1669	More than 700 milligrams (mg)	Sunflower seeds	Eggs, Meat, Milk, Fish, poultry.	Bones and teeth, Efficiency metabolism, Gene expression.	Phosphorus is also part of Deoxyribonucleic acid (DNA) and ribonucleic acid (RNA). Which are necessary components of all cells, in a kids phosphorus Imperfection may visible as reduced production and needed tooth-bone and growth, Approximately Eighty-five percent of Phosphorus in the body merges with calcium in the teeth and bones.
Potassium (K) Atomic number: 19 Group 1: ALKALINE EARTH METAL Investigated in the years: 1807	More than 4500 milligrams (mg)	Tomatoes, green leafy, grains , pumpkin	Meat	Body blood pressure. Nerve and human muscle activity.	Potassium pumped the cell membrane, potassium failure imperfection the body blood pressure and its increased risk of stones and stroke.
Chromium (Cr) Atomic number: 24 Group 6: TRANSITIONAL METAL Investigated in the years: 1798	More than 35 Micrograms (Mcg)	Broccoli, green beans, nuts, types of all Grain.	Egg yolk	Metabolizing formality and rich, insulin activity, Chromium support defends blood sugar levels by Enhancing the quickness of the hormone insulin.	High doses have been linked to more serious side effects including blood disorders, liver or kidney damage, and other problems.
Copper (Cu) Atomic number: 29 Group 11: TRANSITIONAL METAL Investigated in the years: 9000 BC	More than 2 milligrams (mg)	Nuts, types of all Grain, legumes.	Seafood, organ meats (offal)	activity metabolism, body blood formation	Copper imperfection in healthful humans is very scarce. However, those at danger for copper imperfection are individuals with a scarce genetic irregularity.
Fluoride (Fluorine, F) Atomic number: 9 Group 17: HALOGEN Investigated in the years: 1886	More than Micrograms (Mcg)	Tea, portable water (if fluoride-containing or fluoridated)	seafood	Bones and teeth.	Too much fluoride can injure the teeth. Fluor sis only happens during tooth development and cannot be reversed. Construction its Prevention a supercilious antecedence.

Iodine (I) Atomic number: 53 Group 17: HALOGEN Investigated in the years: 1811	More than 150 Micrograms (Mcg)	Iodized salt	Seafood	Thyroid function	Iodine imperfection has the adverse effects level of growth mostly Injurious to the developing brain, feed insufficient in iodine may arise in higher danger for genian retardation.
Iron(Fe) Atomic number: 26 , Group 11: TRANSITIONAL METAL Investigated in the years: 5000 BC	More than 15 milligrams (mg)	Grains, legumes.	Fish, poultry, red meats.	Blood production	The production of the embryo, Infants and junior kids want additional iron to maintain their fast effect and brain development.
Selenium (Se) Atomic number: 34 Group 16: POLYATOMIC NONMETAL Investigated in the years: 1817	More than 45 Micrograms (Mcg)	Types of all Grain, nuts, mushrooms, fruits, and vegetables.	Dairy products, seafood, meat	Antioxidant	Brittleness of hair and nails.
Zinc (Zn) Atomic number: 30 Group 12: TRANSITIONAL METAL Investigated in the years: 1746	More than 15 milligrams (mg)	Types of all Grain, mushrooms, legumes.	Meat, Shellfish, Poultry.	Immune activity, Gene declaration.	Zinc is often granted addition therapeutics for diarrhea. Zinc necessarily is higher in periods of development and growth.

III. OBJECTIVE FUNCTION AND CONSTRAINT

To minimize the whole price of vitamin and minerals for food and unit price particularly .The price function (Z) for the price of one Papaya fresh 276 grams x_1, price of Peanuts(raw)36.50g x_2 ,price of one Broccoli(chopped)156grams x_3,price of one Oranges(fresh medium)131grams x_4 ,price of Tomatoes(sliced raw)180grams x_5,price of Turnip Greens144grams x_6, price of Barley(hulled ,dry) 61.33 grams x_7 ,price of Green beans125grams x_8, price of Carrots(Sliced ,raw)122grams x_9, price of one Egg per 100g x_{10}, price of Cow's Milk(grass-fed) 122 grams x_{11}, price of Chicken 113.40grams x_{12} .The quantity for Vitamin A in this diet content more than 850mcg. Vitamin B1(Thiamin) content more than 1.3gms,Vitamin(B2 Riboflavin) content more than 1.6mg, Vitamin B3(Niacin) content more than 18mg,Vitamin B5(Pantothenic acid) content more than 5mg, Vitamin B6(Pyridoxine) content more than 2mg,Vitamin B7(Biotin) content more than 25mcg, Vitamin B9(Folate) content more than 500mcg,Vitamin B12(Cobalamin) content More than 2mcg,Vitamin C content more than 80mg,Vitamin D content more than 10mcg, Vitamin E content more than15mg,Vitamin K content more than 135mcg,Choline content more than 550mg,Calorie content more than 2500 Calorie, Calcium(Ca) content more than 1000mg, Magnesium (Mg) content more than350mg, Phosphorus (P) content more than 700mg, Potassium (K) content more than 4500mg ,Chromium (Cr) content more than 35mcg, Copper (Cu) content more than 2mg, Iodine (I) content more than 150mcg, Iron (Fe) content more than 15mg, Selenium (Se) content more than 45mcg, Zinc (Zn) content more than 15mg.

Total formulation of the problem:

$$\text{MIN } Z = 7X_1 + 5X_2 + 20X_3 + 5X_4 + 2X_5 + 5.50X_6 + 1.5X_7 + 10X_8 + 3X_9 + 4.5X_{10} + 5X_{11} + 12X_{12}.$$

Subject to,

$$131.10X_1 + 120.74X_3 + 14.74X_4 + 74.97X_5 + 549.34X_6 + 0.67X_7 + 43.75X_8 + 1019.07X_9 + 149X_{10} + 56.12X_{11} + 6.80X_{12} \geq 850,$$

$$0.06X_1 + 0.23X_2 + 0.10X_3 + 0.11X_4 + 0.07X_5 + 0.06X_6 + 0.40X_7 + 0.09X_8 + 0.08X_9 + 0.06X_{10} + 0.06X_{11} + 0.08X_{11} \geq 1.3,$$

$$0.07X_1 + 0.05X_2 + 0.19X_3 + 0.05X_4 + 0.03X_5 + 0.10X_6 + 0.17X_7 + 0.12X_8 + 0.07X_9 + 1.1X_{10} + 0.21X_{11} + 0.13X_{12} \geq 1.6;$$

$$0.99X_1 + 4.40X_2 + 0.86X_3 + 0.37X_4 + 1.07X_5 + 0.59X_6 + 2.82X_7 + 0.77X_8 + 1.20X_9 + 4.0X_{10} + 0.11X_{11} + 15.55X_{12} \geq 18;$$

$$0.53X_1 + 0.64X_2 + 0.96X_3 + 0.33X_4 + 0.16X_5 + 0.39X_6 + 0.17X_7 + 0.09X_8 + 0.33X_9 + 1.4X_{10} + 0.46X_{11} + 1.09X_{12} \geq 5;$$

$$0.10X_1 + 0.13X_2 + 0.31X_3 + 0.08X_4 + 0.14X_5 + 0.26X_6 + 0.20X_7 + 0.07X_8 + 0.17X_9 + 0.04X_{10} + 0.04X_{11} + 0.68X_{12} \geq 2;$$

$$6.40X_2 + 1.31X_4 + 7.20X_5 + 0.58X_6 + 1.27X_7 + X_8 + 6.10X_9 + 16X_{10} + 2.32X_{11} \geq 25;$$

$$102.12X_1 + 87.60X_2 + 168.42X_3 + 39.30X_4 + 27X_5 + 169.92X_6 + 23.3X_7 + 86.78X_8 + 23.18X_9 + 44X_{10} + 6.10X_{11} + 4.54X_{12} \geq 500;$$

$$1.5X_{10} + 0.55X_{11} + 0.39X_{12} \geq 2;$$

$$168.08X_1 + 101.24X_3 + 69.69X_4 + 24.66X_5 + 39.46X_6 + 12.13X_8 + 7.20X_9 \geq 80;$$

$$1.5X_{10} + 1.59X_{11} + 0.11X_{12} \geq 10;$$

$$0.83X_1 + 3.04X_2 + 2.26X_3 + 0.24X_4 + 0.97X_5 + 2.71X_6 + 0.35X_7 + 0.56X_8 + 0.81X_9 + 1.6X_{10} + 0.13X_{11} + 0.31X_{12} \geq 15;$$

$$7.18X_1 + 220.12X_3 + 14.22X_5 + 529.34X_6 + 1.35X_7 + 20X_8 + 16.10X_9 + 0.30X_{10} + 0.37X_{11} + 0.34X_{12} \geq 135;$$

$$16.84X_1 + 19.16X_2 + 62.56X_3 + 11X_4 + 12.06X_5 + 0.43X_6 + 23.65X_7 + 21.13X_8 + 10.74X_9 + 285X_{10} + 17.45X_{11} + 96.73X_{12} \geq 550;$$

$$55.20X_1 + 33.58X_2 + 62.4X_3 + 52.4X_4 + 18X_5 + 197.28X_6 + 20.24X_7 + 55X_8 + 40.26X_9 + 51X_{10} + 137.86X_{11} + 17X_{12} \geq 1000,$$

$$57.9X_1 + 61.32X_2 + 32.76X_3 + 13.10X_4 + 19.80X_5 + 31.68X_6 + 81.57X_7 + 22.50X_8 + 14.64X_9 + 10X_{10} + 12.20X_{11} + 32.89X_{12} \geq 350,$$

$$27.60X_1 + 137.24X_2 + 104.52X_3 + 18.34X_4 + 43.20X_5 + 41.76X_6 + 161.9X_7 + 36.25X_8 + 42.70X_9 + 190X_{10} + 102.48X_{11} + 258.55X_{12} \geq 700,$$

$$502.32X_1 + 257.32X_2 + 457.08X_3 + 237.11X_4 + 426.60X_5 + 292.32X_6 + 277.2X_7 + 182.5X_8 + 390.4X_9 + 140X_{10} + 161.04X_{11} + 290.3X_{12} \geq 4500,$$

$$18.55X_3 + 0.39X_4 + 1.26X_5 + 8.16X_7 + 2.04X_8 + 0.49X_9 + 0.40X_{10} + 0.06X_{11} + 0.67X_{12} \geq 35,$$

$$0.12X_1 + 0.42X_2 + 0.10X_3 + 0.06X_4 + 0.11X_5 + 0.36X_6 + 0.31X_7 + 0.07X_8 + 0.05X_9 + 0.02X_{10} + 0.03X_{11} + 0.06X_{12} \geq 2,$$

$$7.30X_2 + 3.12X_3 + 4.40X_7 + 45X_{10} + 28.06X_{11} \geq 150,$$

$$0.69X_1 + 1.67X_2 + 1.05X_3 + 0.13X_4 + 0.49X_5 + 1.15X_6 + 2.21X_7 + 0.81X_8 + 0.37X_9 + 1.7X_{10} + 0.04X_{11} + 1.18X_{12} \geq 15,$$

$$1.66X_1 + 2.63X_2 + 2.50X_3 + 0.65X_4 + 1.30X_6 + 23.12X_7 + 0.25X_8 + 0.12X_9 + 23X_{10} + 4.51X_{11} + 31.30X_{12} \geq 45,$$

$$0.22X_1 + 1.19X_2 + 0.70X_3 + 0.09X_4 + 0.31X_5 + 1.70X_7 + 0.31X_8 + 0.29X_9 + 1.0X_{10} + 0.4X_{11} + 1.13X_{12} \geq 15,$$

$$119X_1 + 207X_2 + 55X_3 + 62X_4 + 32X_5 + 29X_6 + 217X_7 + 44X_8 + 50X_9 + 156X_{10} + 74X_{11} + 187X_{12} \geq 2500;$$

$$X_1 \geq 0, X_2 \geq 0, X_3 \geq 0, X_4 \geq 0, X_5 \geq 0, X_6 \geq 0, X_7 \geq 0, X_8 \geq 0, X_9 \geq 0, X_{10} \geq 0, X_{11} \geq 0, X_{12} \geq 0.$$

Objective value: 53.68342

X1	0.000000	4.215713	X2	0.000000	1.678922	X3	0.000000	16.40654	X4	0.000000	3.368036
X5	2.711736	0.000000	X6	1.222622	0.000000	X7	7.283082	0.000000	X8	0.000000	8.288752
X9	0.000000	0.8265912	X10	3.851212	0.000000	X11	2.656089	0.000000	X12	0.000000	10.41989.

IV. RESULTS AND DISCUSSIONS

Since this model has 12variables LINGO software (version 18.0) is used to get a solution and the results checked by NCSS (version 12.0.10) and TORA Optimization system windows version 2.00. Solving linear programming problem gives a Global optimal solution as

$Min\ Z =$ Rs 53.68 And for a balanced diet comprised.

1. Tomatoes (sliced raw) 488grams required per day.
2. Turnip Greens176grams requires per day.
3. Barley (hulled, dry) 447 grams per day.
4. Egg Required Three to Four per day.
5. Cow's Milk (grass-fed) 324 grams per day.

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