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Discovery of New Theory Analysis of Equilibrium Point Population Versus Food on Theory of Thomas Robert Malthus and Its Development (Case Study of Indonesia)

Matius Irsan Kasau, ST. Aminah Dinayati Ghani

Abstract: ***The future of humans on this tiny planet earth has entered a grim beginning in the midst of rapidly growing technological progress. How not, human life whose population is growing fast is not comparable to food as a source of life that grows slowly. This study aims to calculate the cross point or equilibrium point between population and food using the population series and food series of Thomas Robert Malthus original and the results of its development by Matius Irsan Kasau. The data and methods used are types of secondary data sourced from the Indonesian Central Statistics Agency (BPS), which is processed by a mathematical method that compares the population with food in each series. The results of research with Indonesian data in 2010 showed that for the original Malthus theory with the number of children on average per couple of 4 people, the distance between generations 25 years, 75 years of life expectancy, population 237 million, food 66.5 million tons obtained equilibrium point occurred in 2085, namely in the third generation. As for Malthus's theory of development results with an average number of children of 2.6 people, a distance between 23 years generation, and 69 years of life expectancy, the equilibrium point was obtained in 2171, namely the seventh generation of the current generation.***

Keywords: Cross point, Equilibrium point, Malthus, Matius.

I. INTRODUCTION

This More than 200 years ago, precisely in 1798 a British pastor and mathematician from the University of Cambridge named Thomas Robert Malthus stated two very famous natural laws of population and food, namely (Asha,1988), (Kasau,2009):

1. The human population tends to increase according to geometric or geometric measurements: 1, 2, 4, 8, 16, 32, ...
2. Food production (natural resources) tends to increase according to arithmetic series or arithmetic: 1, 2, 3, 4, 5, 6, 7, ...
   within a period of every 25 years

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* Correspondence Author
Dr. Matius Irsan Kasau*, M.T, LLDIKTI IX Lecturer, Homebase at STMIK Dipanegara, Technical Information, Makassar, Indonesia. Email: irsan.kasau@dipanegara.ac.id
ST. Aminah Dinayati Ghani, S. Sos., M. Kom, STMIK Dipanegara, Technical Information, Makassar, Indonesia. Email: dinayati.amy@dipanegara.ac.id

Thomas Robert Malthus, the disciple, put forward these two natural laws as a pessimistic (somber) economic response to Adam Smith's economic theory, the teacher who was clearly optimistic. Because of the difference in the rate of growth where the population grows very fast compared to the growth of food production which actually grows very slowly, then there will be a cross over point which is the break-even point between the population and food. This break-even point is called equilibrium point, which is the point where the food crisis starts where the population begins to experience mass hunger and death.

Formulation of the problem

1. How to model two series of Malthus natural laws so that equilibrium points can be known.
2. How to develop or modify the two series of Malthus natural law to be a model with more flexible series of syllables.
3. What is the model of population series rates at equilibrium points both in the original Malthus theory, as well as in the model of development results.

Research purposes

1. Arrange a two-series model of Malthus natural law which can be used to calculate equilibrium points between populations and food.
2. Develop a development model of two more flexible Malthus natural laws that can be used to calculate equilibrium points between populations and food.
3. Model population series rates at equilibrium points both on the original Malthus theory, as well as on the model of development results.

Benefits of research

1. Knowing the time that there will be an imbalance between the population and food so that the population experiences hunger and mass death based on the original Malthus theory.
2. Knowing the time that there will be an imbalance between the population and food so that the population experiences hunger and mass death based on the Malthus theory of development.
3. Knowing the population size and time of occurrence at equilibrium points both in the original Malthus theory, as well as in the model of development results.

II. THEORITICAL REVIEW

Original Malthus Theory

Malthus's two natural laws, both population series and food series, are the number coefficients of the total population and the amount of food capacity at a certain time which continues to increase every 25 years so that a series of tribes is formed.

If it is considered at a certain time the population is G_0 people and the food production capacity at that time is M_0 kg, then the two rows can be written one generation each, and three generations live together (Kasau, Jilid 1 and Jilid 2, 2018):

1. Population Series:

$$D_{po} = 1G_0, 2\,G_0, 4G_0, 8G_0, 16G_0, 32G_0, 64G_0, 128G_0, \;... \quad (2.1a)$$

$$D^3_{po} = 7\,G_0, 14\,G_0, 28\,G_0, 56\,G_0, 112\,G_0, 224\,G_0, 448\,G_0, 896G_0, .. \quad (2.1b)$$

2. Foods Series:

$$D_{pa} = 1\,M_0, 2\,M_0, 3\,M_0, 4\,M_0, 5\,M_0, 6\,M_0, 7\,M_0, 8\,M_0, ...$$

(2.2a)

$$D^3_{pa} = 6M_0, 9M_0, 12M_0, 15M_0, 18M_0, 21M_0, 24M_0, 27M_0, ... \quad (2.2b)$$

The availability of food (K_{kp}) every 25 years can be determined by dividing the food series (2.2) with a population series (2.1), obtained by a series of:

$$K_{kp} = \frac{D_{pa}}{D_{po}} = \left(\frac{1}{1}\right)\left(\frac{M_0}{G_0}\right), \left(\frac{2}{2}\right)\left(\frac{M_0}{G_0}\right), \left(\frac{3}{4}\right)\left(\frac{M_0}{G_0}\right), \left(\frac{4}{8}\right)\left(\frac{M_0}{G_0}\right), \left(\frac{5}{16}\right)\left(\frac{M_0}{G_0}\right), \left(\frac{6}{32}\right)\left(\frac{M_0}{G_0}\right), ... \quad (2.3a)$$

$$K^3_{kp} = \frac{D^3_{pa}}{D^3_{po}} = \left(\frac{6}{7}\right)\left(\frac{M_0}{G_0}\right), \left(\frac{9}{14}\right)\left(\frac{M_0}{G_0}\right), \left(\frac{12}{28}\right)\left(\frac{M_0}{G_0}\right), \left(\frac{15}{56}\right)\left(\frac{M_0}{G_0}\right), \left(\frac{18}{112}\right)\left(\frac{M_0}{G_0}\right), ... \quad (2.3b)$$

Or

$$K_{kp} = (r_0)(K), (r_1)(K), (r_2)(K), (r_3)(K), (r_4)(K), (r_5)(K), (r_6)(K), ... \quad (2.4a)$$

$$K^3_{kp} = (r'_0)(K), (r'_1)(K), (r'_2)(K), (r'_3)(K), (r'_4)(K), (r'_5)(K), (r'_6)(K), ... \quad (2.4b)$$

Or

$$K_{kp} = (r_n)(K),\; n = 0, 1, 2, 3, 4, ...\text{ dan } K = \frac{M_0}{G_0} \quad (2.5a)$$

$$K^3_{kp} = (r'_n)(K),\; n = 0, 1, 2, 3, 4, ...\text{ dan } K = \frac{M_0}{G_0} \quad (2.5b)$$

In case of:

$K_{kp}, K^3_{kp} > 120$, then the food is still abundant

$K_{kp}, K^3_{kp} = 120$, then the food breaks even with the population, the beginning of the food crisis

$K_{kp}, K^3_{kp} < 120$, then food is not enough anymore, there is mass hunger and death.

The number 120 is the Mo food equivalence rate with the Go population, which means that one population needs 10 kg of food to be able to live for one month or 120 kg of food (rice) to live for one year. Therefore the unit of food Mo must be in kilograms where 1 ton = 1000 kg.

Development of the Malthus Theory

The original Malthus Theory has a number of drawbacks as follows Kasau, Jilid 1, 2019), (Kasau, 2012), (Kasau,2009) :

1. The number of series numbers is rigid, so is the time range of population folding 25 years.
2. There is no correlation between the population series and the food series. Both series grow on their own from the tribe to the next tribe separately.
3. Less formulated clearly so implementing it is very vague.

These shortcomings can be corrected, among others, by taking into account the influence of population and food growth which is a function of: pair factor " a " defined as half of the average number of children per couple, distance between generations T and U_{hh} life expectancy. For U_{hh} = 3T population growth and food can be expressed (Kasau, Jilid 1 and Jilid 2, 2018):

Population 1 and 3 generations:

$$G_{nT} = a^n\, G_0 \quad ; n = 0, 1, 2, 3, 4, ... \quad (2.6a)$$

$$G^3_{nT} = a^n\,(1 + a + a^2)G_0 \quad ; n = 0, 1, 2, 3, 4, ... \quad (2.6b)$$

1 and 3 generation food:

$$M_{nT} = M_0\{1 + n(a-1)\} \quad ;; n = 0, 1, 2, 3, 4, ... \quad (2.7a)$$

$$M^3_{nT} = 3M_0\{a + n(a-1)\} \quad ; n = 0, 1, 2, 3, 4, ... \quad (2.7b)$$

Therefore the situation of food availability 1 and 3 generations has a tribe with the equation:

$$K_{kp} = \frac{M_{nT}}{G_{nT}} = \left[\frac{\{1+n(a-1)\}}{a^n}\right]\left(\frac{M_0}{G_0}\right) = (r_n)(K) \quad ; n = 0, 1, 2, 3, 4, ... \quad (2.8a)$$

$$K^3_{kp} = \frac{M^3_{nT}}{G^3_{nT}} = \left[\frac{3\{a+n(a-1)\}}{a^n(1+a+a^2)}\right]\left(\frac{M_0}{G_0}\right) = (r'_n)(K) \quad ; n = 0, 1, 2, 3, 4, ... \quad (2.8b)$$

Note that for the average number of children per couple is 4 people or pair factor a = 2, then the terms of the original Malthus theory 1 and 3 generations live together, but for the average number of children per couple or pair factor other Malthus theories The original is no longer valid so that the theory of the results of its development can be broadly varied and flexible. Table 1 shows the ratio of food to population in each generation for 5 different pair factors, namely: 1; 1.3; 1.5; 2.0 (Malthus), and 2.5.

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Table 1 Eleven (11) Series of Coefficients of The Ratio of Food to Populations 1 and 3 Generations for 5 Number of hildren or Different Pair Factors.

Series term to (n)	*a*									
	1,0		1,3		1,5		2,0 (Malthus)		2,5	
	r_n	r'_n	r_n	r'_n	r_n	r'_n	r_n	r'_n	r_n	r'_n
0	$\left(\frac{1}{1}\right)$	$\left(\frac{1}{1}\right)$	$\left(\frac{1}{1}\right)$	$\left(\frac{3,9}{3,99}\right)$	$\left(\frac{1}{1}\right)$	$\left(\frac{4,5}{4,75}\right)$	$\left(\frac{1}{1}\right)$	$\left(\frac{6}{7}\right)$	$\left(\frac{1}{1}\right)$	$\left(\frac{7,5}{9,75}\right)$
1	$\left(\frac{1}{1}\right)$	$\left(\frac{1}{1}\right)$	$\left(\frac{1,3}{1,3}\right)$	$\left(\frac{4,8}{5,187}\right)$	$\left(\frac{1,5}{1,5}\right)$	$\left(\frac{6,0}{7,125}\right)$	$\left(\frac{2}{2}\right)$	$\left(\frac{9}{14}\right)$	$\left(\frac{2,5}{2,5}\right)$	$\left(\frac{12}{24,375}\right)$
2	$\left(\frac{1}{1}\right)$	$\left(\frac{1}{1}\right)$	$\left(\frac{1,6}{1,69}\right)$	$\left(\frac{5,7}{6,743}\right)$	$\left(\frac{2}{2,25}\right)$	$\left(\frac{7,5}{10,688}\right)$	$\left(\frac{3}{4}\right)$	$\left(\frac{12}{28}\right)$	$\left(\frac{4}{6,25}\right)$	$\left(\frac{16,5}{60,938}\right)$
3	$\left(\frac{1}{1}\right)$	$\left(\frac{1}{1}\right)$	$\left(\frac{1,9}{2,197}\right)$	$\left(\frac{6,6}{8,766}\right)$	$\left(\frac{2,5}{3,375}\right)$	$\left(\frac{9,0}{16,031}\right)$	$\left(\frac{4}{8}\right)$	$\left(\frac{15}{56}\right)$	$\left(\frac{5,5}{15,625}\right)$	$\left(\frac{21}{152,344}\right)$
4	$\left(\frac{1}{1}\right)$	$\left(\frac{1}{1}\right)$	$\left(\frac{2,2}{2,856}\right)$	$\left(\frac{7,5}{11,396}\right)$	$\left(\frac{3}{5,063}\right)$	$\left(\frac{10,5}{24,047}\right)$	$\left(\frac{5}{16}\right)$	$\left(\frac{18}{112}\right)$	$\left(\frac{6}{39,063}\right)$	$\left(\frac{25,5}{380,859}\right)$
5	$\left(\frac{1}{1}\right)$	$\left(\frac{1}{1}\right)$	$\left(\frac{2,5}{3,713}\right)$	$\left(\frac{8,4}{14,815}\right)$	$\left(\frac{3,5}{7,594}\right)$	$\left(\frac{12,0}{36,070}\right)$	$\left(\frac{6}{32}\right)$	$\left(\frac{21}{224}\right)$	$\left(\frac{7,5}{97,656}\right)$	$\left(\frac{30}{952,148}\right)$
6	$\left(\frac{1}{1}\right)$	$\left(\frac{1}{1}\right)$	$\left(\frac{2,8}{4,827}\right)$	$\left(\frac{9,3}{19,259}\right)$	$\left(\frac{4}{11,391}\right)$	$\left(\frac{13,5}{54,105}\right)$	$\left(\frac{7}{64}\right)$	$\left(\frac{24}{448}\right)$	$\left(\frac{9}{244,141}\right)$	$\left(\frac{34,5}{2380,371}\right)$
7	$\left(\frac{1}{1}\right)$	$\left(\frac{1}{1}\right)$	$\left(\frac{3,1}{6,275}\right)$	$\left(\frac{10,2}{25,037}\right)$	$\left(\frac{4,5}{17,086}\right)$	$\left(\frac{15,0}{81,158}\right)$	$\left(\frac{8}{128}\right)$	$\left(\frac{27}{896}\right)$	$\left(\frac{10,5}{610,352}\right)$	$\left(\frac{39}{5950,928}\right)$
8	$\left(\frac{1}{1}\right)$	$\left(\frac{1}{1}\right)$	$\left(\frac{3,4}{8,157}\right)$	$\left(\frac{11,1}{32,548}\right)$	$\left(\frac{5}{25,629}\right)$	$\left(\frac{16,5}{121,737}\right)$	$\left(\frac{9}{256}\right)$	$\left(\frac{30}{1792}\right)$	$\left(\frac{12}{1525,879}\right)$	$\left(\frac{43,5}{14877,319}\right)$
9	$\left(\frac{1}{1}\right)$	$\left(\frac{1}{1}\right)$	$\left(\frac{3,7}{10,604}\right)$	$\left(\frac{12}{42,312}\right)$	$\left(\frac{5,5}{38,443}\right)$	$\left(\frac{18,0}{182,606}\right)$	$\left(\frac{10}{512}\right)$	$\left(\frac{33}{3584}\right)$	$\left(\frac{13,5}{3814,697}\right)$	$\left(\frac{48}{37193,298}\right)$
10	$\left(\frac{1}{1}\right)$	$\left(\frac{1}{1}\right)$	$\left(\frac{4}{13,786}\right)$	$\left(\frac{12,9}{55,001}\right)$	$\left(\frac{6}{57,665}\right)$	$\left(\frac{19,5}{273,909}\right)$	$\left(\frac{11}{1024}\right)$	$\left(\frac{36}{7168}\right)$	$\left(\frac{15}{9536,743}\right)$	$\left(\frac{52,5}{92983,246}\right)$

Source: Processed according to equations (2.8a) and (2.8b), distance between years T, Malthus T = 25 years

The numbers in Table 1 show the values of r_n and r'_n with values of n = 0,1,2, ..., 10 which if multiplied by the value K $\left(=\frac{M_o}{G_o}\right)$ will get the value K_{kp} and K^3_{kp}. Note that for the total number of children per couple of 2 people or pair factor (a) is 1, then it can be seen in Table 1 the comparison coefficient of the serial rate does not change, but always remains $\left(\frac{1}{1}\right)$. This shows that the amount of population and food produced all the time is always available safely, never going up or down. Meanwhile, the greater the pair factor or the more the number of children on average per couple the coefficient of comparison of the series of rates decreases. This shows that the increase in population is far greater than the increase in food, so that the time of food insecurity and the food crisis is accelerating.

Strengths, Weaknesses, and Mistakes of Malthus Theory

a. Advantages

1. Strong and fundamental natural law that can be expanded and developed
2. Applies specifically such as: Theorem of Pythagoras (trigonometric mathematics), Newton's Law (Physics), Adam Smith's Economic theory (macroeconomics), Cobb-Douglas production theory (microeconomics) and so on.
3. "Early Warning Bells" will occur "Explosion of Population" which will lead to famine and mass death due to the food crisis.
4. Is the "Forerunner" inspiration of the end of the Family Planning program (KB) throughout the world.

b. Deficiency

1. Population series numbers (1, 2, 4, 8, ...) are rigid which cannot be changed so that they only apply specifically. Likewise, the food series numbers (1, 2, 3, 4, ...).
2. The period of occurrence of "population folding" and food is 25 years which is also stiff so it cannot be applied in general.
3. Only can count the population that will end in every multiple of 25 years, but cannot count the number of population that has died in every multiple times 25 years ago.
4. Less formulated clearly so it is very vague in implementing it.
5. Not taking into account the influence of various factors such as: social, cultural, economic, political, educational level, technological progress and other factors that can actually change the size of the population and food series figures and the 25-year period.

c. Mistakes

Besides Malthus's theory has advantages and disadvantages (Kasau, 2018), it also has a real error in both series.

1. In the population series, population growth is 100 percent per 25 years or 4 percent per year which is constant over time. This is in addition to being very rarely fulfilled because it is too large, also requires pair factor 2 or the number of children on average per couple of 4 people which is very difficult to meet by various countries in general, except for only a few countries in Africa such as Kenya.
2. In the food series, food growth is initially 100 percent per 25 years or 4 percent per year. Furthermore, food growth in the next generation every 25 years continues to decline: 50 percent, 33.33 percent, 25 percent, 20 percent, 16.67 percent, 14.29 percent, and so on. Or per year: 4 percent, 2 percent, 1.33 percent, 1 percent, 0.8 percent, 0.67 percent, 0.57 percent. This is very different from the actual food growth which tends to fluctuate around 3 percent per year.

Research Hypothesis

1. Based on the original Malthus equilibrium point between the population and food in Indonesia it is predicted that it will occur around 100 years from now.
2. Based on the theory, the results of the development of the theory of Malthus equilibrium point between the population and food in Indonesia are predicted to occur around 200 years from now.
3. The population at equilibrium point in Indonesia is predicted to be between 1 billion and 2 billion with food needs of around 120 billion kg to 240 billion kg of rice per year.

III. RESEACH METHOD AND RESULT

This study took the case of Indonesia, using secondary data in 2010 sourced from the 2016 BPS as follows: Food production (rice) 66,469,394 tons (M_0^3) with an average increase of 3.63 percent per year. The population based on the results of the 2010 census was 237,641,326 people (G_0^3) with a growth of around 1.5 percent (ρ) per year. The number of children per couple is 2 to 3 people, on average 2.6 people (a = 1.3) with the average age ending the first child 23 years (T = 23). 69 years of life expectancy $(U_{hh} = 69)$. The level of consumption of food (rice) is 100 kg to 124 kg, averaging around 120 kg per year. The calculations performed are based on the original Malthus theory and Malthus's theory as a result of the development of both population and food as described in the theoretical study which is based on the reference book Jilid 1 and Jilidf 2 by Matius Irsan Kasau (2018). Specifically for the original Malthus theory, the average number of children per couple is 4 (a = 2), the average age of ending the first child or the intergenerational distance is 25 years (T = 25), and life expectancy is 75 years $(U_{hh} = 75)$. Of these three data, Malthus himself only mentions the occurrence of multiples twice in every 25 years. While the number of children on average per couple and life expectancy is not mentioned at all. But both of these things can be known implicitly in a geometric series of populations.

Equilibrium point calculation for original Malthus theory

$T = 25$ years, $a = 2, U_{hh} = 75$ years

Based on equation (2.7b) obtained:

$M_o^3 = 3aM_o$ or $M_o = \frac{M_o^3}{3a} = \frac{66.469.394.000}{3(2)} = 11.078.232.333$

Based on equation (2.6b) obtained:

$G_o^3 = (1 + a + a^2)G_o$

or $G_o = \frac{G_o^3}{(1+a+a^2)} = \frac{237.641.326}{7} = 33.948.761$

$K = \frac{M_o}{G_o} = 326$

Based on equation (2.8a) and (2.8b) obtained:

$K_{kp} = r_n K = 326 r_n = 120$ or $r_n = 0,368$

$K_{kp}^3 = r_n' K = 326 r_n' = 120$ or $r_n' = 0,368$

From Table 1 column $a = 2$ (Malthus) obtained the ratio of r_n and r_n' whose value is around 0.368 is $r_n =$ located between $\left(\frac{4}{8}\right)$ and $\left(\frac{5}{16}\right)$, while for $r_n' =$ located between $\left(\frac{12}{28}\right)$ with $\left(\frac{15}{56}\right)$.

This comparative number is located in lines n = 2, n = 3, and n = 4. The average or middle number is n = 3, which means the third generation of the initial generation (n = 0). Because according to Malthus' theory the distance between generations is 25 years, then the food crisis that causes mass starvation and death in Indonesia will occur at the fastest nT = (3) (25) = 75 years from 2010 or in 2085.

Calculation of equilibrium points for the Malthus theory of development.

$T = 23$ years, $a = 1,3, U_{hh} = 69$ years

$M_o^3 = 3aM_o$ or $M_o = \frac{M_o^3}{3a} = \frac{66.469.394.000}{3(1,3)} = 17.043.434.359$

Based on equation (2.6b) obtained:

$G_o^3 = (1 + a + a^2)G_o$

or $G_o = \frac{G_o^3}{(1+a+a^2)} = \frac{237.641.326}{3,99} = 59.559.230$

$K = \frac{M_o}{G_o} = 286$

Based on equation (2.8a) and (2.8b) obtained:

$K_{kp} = r_n K = 286 r_n = 120$ or $r_n = 0,420$

$K_{kp}^3 = r_n' K = 286 r_n' = 120$ or $r_n' = 0,420$

From Table 1 column $a = 1,3$ the ratio of r_n and r_n' is obtained, whose value is around 0.420 is $r_n =$ located between $\left(\frac{3,1}{6,275}\right)$ and $\left(\frac{3,4}{8,157}\right)$, while for $r_n' =$ located between $\left(\frac{9,3}{19,259}\right)$ and $\left(\frac{10,2}{25,037}\right)$. This comparative number is located in lines n = 6, n = 7, and n = 8. Average or middle number n = 7 which means generation

seventh from the initial generation (n = 0). Because based on the development of Malthus's theory of intergenerational distance (Indonesian data) of 23 years, the food crisis that causes mass starvation and death in Indonesia will occur at the fastest nT = (7) (23) = 161 years from 2010 to come or in 2171.

Note that equilibrium points for pair factor a = 1.5 are definitely faster than for pair factor a = 1.3 and slower than for pair factor a = 2 (Malthus) or around generation n = 4, 5, and 6 While for pair factor a = 2.5 which is greater than Malthus' theory, it will be even faster, which is around generation n = 1, and 2.

This explanation shows that the more the number of children on average per couple and the smaller the interval between generations, the faster the equilibrium point will occur.

Table 2. Original Malthus Theory and Its Development Results, Results of Implementation in Indonesia

Malthus's theory	T (years)	U_{hh} (years)	a	The occurrence of equilibrium points in the generation to	the old from 2010	Namely in the year
Original	25	75	2	3	75	2085
Development	23	69	1,3	7	161	2171
			1,0	~	~	~
			1,5	Around 4, 5, and 6	115	2125
			2,5	About 1, and 2	35	2045

Source: calculation results using equations (2.4a) and (2.4b) and conversion to Table 1
~ equilibrium point in an infinite place
(never happened)

Table 3. Population and food conditions of the Original Malthus Theory (2085) and its Development (2171) at Equilibrium Points, Results of Application in Indonesia

Malthus's theory	T (years)	U_{hh} (years)	a	n	Population in year (billion people)		Food (rice) in the year (billion Kg)	
					2085	2171	2085	2171
Original	25	75	2	3	1,901	---	166,173	---
Development	23	69	1,3	7	0,522	1,491	112,487	173,843

Source: calculation results using equations (2.6b) and (2.7b).

Based on the results of calculations in Table 2 and Table 3, the population graph and food of the original Malthus theory and its development as a function of time, calculated from 2010 as the initial calculation until the occurrence of equilibrium points, can be described as in Figure 1.

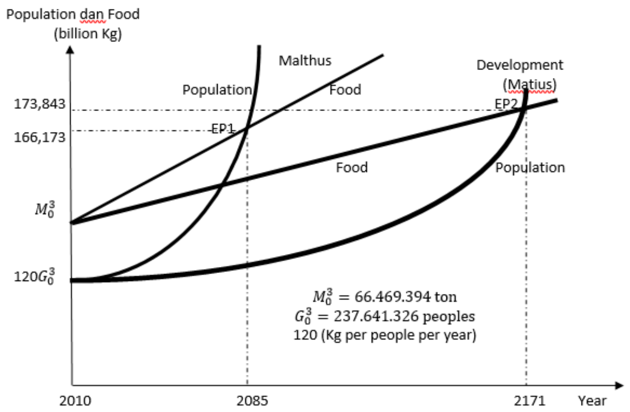

Figure 1 : Graph of the Equilibrium point of the original Malthus theory and its Development

Note Figure 1 shows that equilibrium point 1 (EP1) shows the break-even point based on the original Malthus theory, while equilibrium point 2 (EP2) shows the break-even point based on the results of development. Both are different in 86 years. This is caused by differences in 3 things, namely the number of children on average per couple, distance between generations, and life expectancy. As a criticism of the original Malthus theory and the results of its development, there are two weaknesses in the food series as follows:

1. The initial food data M_0^3 used is data in 2010 obtained equilibrium point EP1 and EP2 as shown in Figure 1. If the food data was initially advanced for example in 2000, the equilibrium points EP1 and EP2 also progressed to the year before 2085 and year 2171.
2. The amount of food needed in equilibrium points EP1 and EP2 is not necessarily the maximum capacity of all agricultural areas in Indonesia. The numbers mentioned in Figure 1 can be below or above the maximum capacity.

However, assuming these two weaknesses do not occur, the analysis and discussion of the results of the study are as follows:

Analysis and Discussion of Research Results

It can be seen in Table 2 and Figure 1 that the original Malthus theory only needed 3 generations or 75 years calculated from 2010 to reach equilibrium points, namely in 2085. The population in 2010 around 238 million people would reach 1.901 billion people in equilibrium points with the number food needed 166,173 billion Kg per year as shown in Table 3. Different from Malthus Development theory requires 7 generations or 161 years calculated from 2010 to achieve equilibrium points, namely in 2171.

The population in 2010 was around 238 million people, reaching 1,491 billion people in equilibrium point with the amount of food needed 173,841 billion Kg per year as shown in Table 3. Look again at Table 2, the greater the pair factor a or the more the number of children per wife the fewer the number of generations needed or the faster it reaches the equilibrium point, even for pair factor a equals 1 or the number of children on average per couple equilibrium points never occur or occur in infinite places (~). This is very easy to understand because for the average number of children per couple 2 people, the population from time to time never increases, the last number always equals the number of dead.

IV. CONCLUTION AND DISCUSSION

A. Conclussion

1. The population and food model for calculating equilibrium points between population and food has been reduced so that equilibrium points can be known.
2. The equilibrium point of the original Malthus theory in Indonesia calculated from 2010 (the latest population census data) will occur in the third generation (generation of great-grandchildren from the population of 238 million from the 2010 census).

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This will happen in 2085. This year Indonesia's population reaches 1,901 billion people with food production (rice) of 166,173 billion kilograms. Hunger and mass death will occur after 2085 due to food insufficiency.

3. Equilibrium point on Malthus theory of development results in Indonesia calculated from 2010 (the latest population census data) will occur in the seventh generation (generation of grandchildren from the population of fifth generation of population 238 results of the 2010 census). This will occur in 2171. This year Indonesia's population is 1,491 billion people with food production (rice) of 173.843 billion kilograms. Hunger and mass death will occur after the year 2171 due to food insufficiency.

B. Suggesion

1. Note that based on the Malthus theory the food crisis that causes mass starvation and death will occur in 2085. This will really happen if the number of children on average per couple is 4 people with a distance between generations of 25 years. Unlike the theory of development results based on 2010 census data, BPS 2016, the food crisis that causes hunger and mass death will only occur in 2171. This will really happen if the average number of children per couple is 2.6 with intervals between generations are 23 years. Note also that if the average number of children per couple is 2.0 people with arbitrary intervals between generations, then the food crisis that causes hunger and mass death will never occur. Because that as a suggestion to avoid a food crisis must be pursued the success of family planning (KB) with the slogan "2 children is enough" or "2 children better" really successful carried out.
2. Based on calculations with Malthus's theory, Indonesia can only support a maximum of 1.9 billion people, while in theory the results of the development of around 1.5 billion people. Average of around 1.7 billion people. This means that famine and mass death can be avoided, it is recommended that the maximum amount be shunned to never be achieved in the manner described in item 1. It is important to remember that as much as needed to feed humans about 170 billion kilograms of rice per year is appropriate with the maximum capacity of agricultural areas in Indonesia.

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AUTHORS PROFILE

Matius Irsan Kasau is an associate professor in Indonesia, home-base at STMIK Dipanegara Makassar. He has over thirty years of experience in teaching and researching. He got his bachelor's degree in Electronical Engineering from Universitas Hasanuddin Makassar and master's degree in Control and Instrumentation from Institut Teknologi Bandung, Indonesia. He achieved his doctoral degree in Economics from Universitas Hasanuddin. His research interests are on engineering, economics development, economics theory, economics agriculture, etc.

ST. Aminah Dinayati Ghani is a member of INDOCEISS and APTIKOM assosiasoin in Indonesia, home-base STMIK Dipanegara Makassar. She got her bachelor's degree in Public Economic from STIA-LAN Makaassar and master's degree in Information Technologi from Dian Nuswantoro Semarang.. She has also published more than 10 research papers in various national and international publications.