

# Mathematical Model of the Relationship Between Four Noble Truths

Basant Kumar Basnet

## Abstract

*Four Noble truths are the foundation for Buddhism and are more significant in Buddha's teaching. Moreover, the four noble truths and noble eightfold path were taken as a vessel to transcend Buddha's self-realisation into collective understanding. This paper focuses on investigating the interrelationship between four noble truths using existing mathematical models. The study follows a qualitative research design, inductive approach, and content analysis strategy for collecting and analysing the data. Furthermore, conditional relation and biconditional relation were also applied as a tool for finding the results. The literature suggests that the first major section of four noble truths contains first and second noble truth (related to each other) is related to the realm of death and rebirth whereas the second major section that contains third and fourth noble truths (related to each other) is not the part of cause and effect. However, it was found that the first, second, and fourth noble truths are related to each other by the relation of cause and effect which is shown in mathematical relation (model).]*

**Keywords:** Four Noble Truths, Interrelationship, Buddhism, Cause and effect, Vicious circle, Samsara, Death, Rebirth, and Mathematical model.

## Introduction

Four noble truths are the fundamental tenets of Buddhism and have the most considerable significance in Buddha's teachings. These represent the four basic pillars, on which the entire system of Buddhism is perched. Over 2500 years ago, in Bodhgaya (City of India), sitting under the Bodhi tree, after being awakened, Buddha remained silent for 49 days (TSERING, 2005). At that point, he moved from Bodhgaya to Sarnath. In Sarnath, at Deer Park, he met his five ascetics companions with whom Buddha had a challenging fellowship of six years. After the reunion, for the very first time, Buddha preached four noble truths to these five ascetics Koudanna, Mahanama, Bhaddiya, Vappa, and Assaji, and set a foundation of Buddhism (Nhát Hánh, 1991). After listening to Buddha's first sermon, these five ascetics became the first group of Buddhist monks called pañcavaggiyā. These teachings of four noble truths are explained in the *Sutta on the Turning of the Dhamma Wheel (DhammacakkappavattanaSutta, Saṃyutta Nikāya, 56:11)* (Gordon et al., 2015, p.9).

In ancient medicine, during Buddha's period, practitioners were implementing the fourfold scheme of disease, diagnosis, cure and treatment which are closely related to four noble truths of Dukkha (Suffering), Samudaya (Cause of suffering), Nirodha (Ending of suffering) and Magga (Noble eightfold path) (Santina, 1997, p.44 - 45). Over here we anticipate the order of occurrence of four noble truths in real cases is not a matter of importance; preferably, how it came to action is more critical (Side, 1997, p.36-37). Any person who is suffering from illness first realises illness, then diagnosed for the cause of illness, then after gets an idea of cure and finally he follows the procedure

of treatment. In this explanation, we identify the therapeutic nature of four noble truths while; Gordon et al. (2015) has related four noble truths with their individual and collective approaches towards the practice of mindfulness. After Buddha's enlightenment, Buddha needed words to shape his self-realisation and then Buddha needed vessels like four noble truths and a noble eightfold path to pour his understanding into them (Hanh, 2008). In this section, Hanh tries to relate four noble truths as a message carrying vessel. In the important notification offered by Santina (1997, p.46 - 47), the first two noble truths of Dukkha and Samudaa are related to each other by the recycling circle of birth and death or samsara while the other two noble truths of Nirodha and Magga are not related to the realm of birth and death. Additionally, Santina mentioned that noble truths can be causally related to one another, and he has separated four noble truths into two major sections: The first section deals with a vicious cyclic circle of death and birth while the second one carries a particular out of the circle of death and birth into a completely new domain of freedom.

The literature review reveals that four noble truths are taken as the backbone of Buddhism, and it also incorporates the causal relationship between four noble truths. However, it is arguable that there is a possibility of elaborating the interrelationship between four noble truths. For instance, Santina (1997, p.46) has separated the second section of third and fourth noble truths from the recycling cause and effect relation, but this paper tends to assess "a probability of relating the fourth noble truths of the noble eightfold path with the vicious circle of death and rebirth." Moreover, there is an enormous gap in terms of arranging all four noble truths genuinely concerning each other. Till now mathematical modelling that could illustrate the interrelationship between four noble truths also remains an untouched part. Hence, a contemporary perspective is required to research in these areas. This research paper is centred around two major research questions (RQ) which are as follows:

*RQ1. How are the four noble truths interrelated with each other ?*

*RQ2. Does the fourth noble truth have any relationship with the first and second noble truths?*

In this research article, the author tries to generate interrelationship between the four noble truths and generates a process flow chart that will picture a distinct vision of interrelationship.

## **Theory: Four Noble Truths (the first turning wheel of dharma)**

The theory of this research is based on the four noble truths of the Buddha's teaching and these four noble truths have been described one by one in this chapter under the sub-heading of each noble truth below.

### **First Noble Truth:**

Tsering (2005) mentioned Buddha's first noble truth in his book as "*Now this, bhikkhus, is the noble truth of suffering: birth is suffering, ageing is suffering, illness is suffering, death is suffering; union with what is displeasing is suffering; separation from what is pleasing is suffering; not to get what one wants is suffering; in brief, the five aggregates subject to clinging are suffering.*"

This discourse defines that there are two types of sufferings in life, those that endure physiologically (ageing, illness, death, and birth, etc.) and psychological suffering (displeasing, separation from

what is pleasant, non-fulfilment of wishes and desires etc.) (Thera, 1994). Dealing with the very first noble truth as the existence of suffering, often people react as if Buddhism has a pessimistic approach, but the author tries to abbreviate this issue to the existing fact of suffering (Santina, 1997, p.47-48). Moreover, Santina adds if a suffering man does not reveal his suffering and deny it, then there is no possibility to seek a cure for his/her suffering. It is engrossing to know that according to Western medical conventions (defined by the World Health Organisation), in the absence of pain and while experiencing favourable socio-environmental conditions individuals are not treated as suffered or ill persons. However, within Buddhism, suffering acquired profound meaning, irrespective of sentient beings feeling psychological or somatic pain, every unenlightened being that exists inevitably suffers (Gordon et al., 2015).

## **Second Noble Truth**

Tsering (2005) mentioned Buddha's second noble truth in his book as *"Now this, bhikkhus, is the noble truth of the origin of suffering: it is this craving that leads to renewed existence, accompanied by delight and lust, seeking delight here and there; that is, craving for sensual pleasures, craving for existence, craving for extermination."*

Craving remains the primary cause of suffering and it may be for anything you desire, that one does not want to let go of or want to keep it, maintain it. There are three types of cravings. The first craving is for sensual pleasure (Kama Tanha), the second craving is Bhav Tanha (existential) and Vibhava Tanha (extermination) (Sumedho, 1992, p.28-29). Sumedho adds Kam-tanha is the demand for sensual pleasure (either at the physiological or psychological level), bhava-tanha is craving for existence (e.g., I have anger, and I want to get rid of it.) while vibhava-tanha is craving for non-existing. It is something like when one craves for something with the deepest level of his effort and does not attain success then one tries to suicide or tries to end that course. For the question, is craving only responsible for suffering? "The answer is no! there is something that goes deeper than craving, something that is, in a sense, the foundation or ground of craving – namely, ignorance" (Santina, 1997, p.52). Ignorance of something leads to suffering. If one does not know how to swim, the swimming situation is constantly threatened to him.

## **Third Noble Truth**

Tsering (2005) mentioned Buddha's third noble truth in his book *"Now this, bhikkhus, is the noble truth of the cessation of suffering: it is the remainder less fading away and cessation of that same craving, the giving up and relinquishing of it, freedom from it, non-reliance on it."*

Cessation of suffering is different from being cured of physical disease. In the case of physical disease, it may recur but cessation in the third noble truth is a complete cure. This cessation is not woven by the fabric of cause and effect (TSERING, 2005). When all the causes of suffering related to the first and second noble truths are gone then as a result this state occurs. When one understands the whole truth of life then grief and sorrow are removed and flowering happens (Nhật Hạnh, 1991). A suffering person should be convinced of the existence of suffering. This leads to the realisation of the ending of suffering. Though most of the suffering people don't know about the ending of suffering but authority of Buddha gives a mindset to the listeners about ending suffering. This is a matter of faith and authority. To realise this third noble truth, one should go through practising the noble eightfold path (Mahathera, 2010, p.48).

## Fourth Noble Truth

Tsering (2005) mentioned Buddha's fourth noble truth in his book *"Now this, bhikkhus, is the noble truth of the way leading to the cessation of suffering: it is this noble eightfold path; that is, right view, right intention, right speech, right action, right livelihood, right effort, right mindfulness, right concentration."*

In China, the noble eightfold path is called the path of eight right practices. In pali right is samma and in Sanskrit, it is called samyak which means "In the right way" (Hanh, 2008). The first three noble truths set a framework for the implication of the fourth noble truth of the noble eightfold path (Gethin & Gethin, 1998, p.79). The fourth noble truth is the most flowering part of all four truths. Though they all combinedly make a whole working network, in the fourth noble truth perfect effort, true practice, and deep insight are needed to understand the noble eightfold path. The noble eightfold paths are - right view, right intention, right speech, right action, right livelihood, right effort, right mindfulness and right concentration; they all have their fragrance, and they are the cream of the crop in Buddhism.

According to Sumedho, (1992, p.49) the noble eightfold path is grouped into three parts

**Wisdom:** It contains the right understanding and right aspiration.

**Morality:** It contains right speech, right action and right livelihood.

**Concentration:** It contains the right effort, right mindfulness and right concentration.

In short, the four noble truths are

- 1- There is suffering in life.
- 2- There are causes of suffering in life.
- 3- There is an ending to suffering.
- 4- There is a noble eightfold path to end the suffering.

## Methodology

This study investigates and tries to understand the interrelationship between four noble truths by using conditional relation, biconditional relation, and probability flow tree. This type of procedure is mainly used for analysing theoretical limits of statements to represent precise ideas whereas conditional relation for forming a logical compound statement in which a statement "p", called the antecedent, implies a statement "q", known as consequent and, a biconditional relation to form a combination of a conditional statement and its converse that is written in "if and only if" form (Howson, 1997; Klenk, 2008). This chapter incorporates how the entire research has been designed to investigate the research questions RQ1 and RQ2 of this study.

This study tries to understand, describe and discover the relationship between four variables which are four noble truths in this case (see Theorem section) therefore, it was necessary to design the research as qualitative. This type of research best fits for investigating the research problems through understanding, describing, and discovering new knowledge, possibilities, hypotheses, or theories (Saunders et al., 2016, p. 566 - 625). Moreover, qualitative research is mainly associated with a diversity of strategies and each of them has a specific emphasis, scope, and set of phenomena (Christensen & Johnson, 2013). The philosophical roots for the study were taken as constructivism. This type of philosophy helps researchers to think of reality from different perspectives as there

could be multiple realities regarding the research problem of inquiry (Merriam, 2009 & Leavy, 2007). The reality could be relative and can be influenced by many factors therefore, it was important to approach the research problem with this sort of philosophy so that the researcher can approach the research problem from different angles to discover new knowledge. Moreover, the research follows an inductive approach as it tends to develop possible hypotheses or a theory from the analysed data (Leavy, 2017). Also, inductive research is more flexible in adding knowledge at any point of the research and adding knowledge at different points of cross-sectional time horizon for this research and it was the most significant part to develop a new perspective from its possible findings.

The background of this research is based on the theoretical literature review where the existing literature about the four noble truths was concisely reviewed to understand the current knowledge as well as to find the possible gaps from the previous works. The author has conducted a series of literature reviews based on previous work done in the same domain to build the background for this research. For a better understanding of the existing knowledge, initially, the literature search was conducted using some useful keywords like fourth noble truths, interrelationship, mathematical model, Buddhism, cause and effect, and other related words in context to the research topic. The main databases used for the initial literature search were Scopus, Springer, Emerald journals, Google books, EBSCOHost, EJS, Proquest Religion, etc. However, physical books, printed books, and printed research articles in the same domain were also reviewed.

The data collection procedure was done through specifically selected works of previous studies i.e. secondary data was collected from the previous works closely related to the research topics. The secondary data helped to grab some useful claims and find the research gaps as mentioned in the introduction chapter of this paper. Since the research was meant to understand, describe, and discover the relationship between four variables (four noble truths) and formulate a mathematical model for the relationship between the variables, therefore, secondary data was critically important and the strategy applied for this was the content analysis from the selected documents (articles & books) closely related to the topic of this research. Similarly, for analysing the data content analysis technique was used as it is flexible for finding patterns, gaps and helps to understand the context in wider perspective from the existing literature about the same topic (Saunders et al., 2016, pg. 566 - 624). One of the key aspects of this technique was to transform a large amount of text into a highly organised, and concise summary of the key results. Furthermore, a different approach was also taken using conditional relation, and biconditional relation to derive the findings and identify further possibilities. After analysing the data, a mathematical model was drawn as shown in the theorem section. The implication of the model was used for a better understanding of the relationship among the variables (four noble truths). However, it was also applied to formulate and figure out any possible new relationships according to the requirement of the research questions.

Fundamental principles of Abhidhamma states that all things (dhamma) are causally related and the purpose of Abhidhamma is to understand the reality of life through a direct understanding of cause-and-effect relation (Anderson & Anderson, 1999, p.85). If and then relation (cause and effect relation) plays a vital role in understanding and discovering the relationship between four variables. This work is an applied form of implication (conditional and biconditional) relation in the field of philosophy. Limitations of this method are confined to the logic employed in the philosophical domain. In another field of the philosophical domain, the results may occur differently but still, the processing pattern will remain the same.

## Mathematical model of the relationship between four noble truths based on cause and effect:

Four noble truths have a robust relationship with each other. We can see proof of this using if and then conditional and biconditional relation (cause-and-effect) and then check how the four noble truths are interrelated using probability flow charts.

The possible connectives used to form a compound statement are as follows in the given table 1:

**Table 1:** Connectives Used to form a compound statement.

Connectives	Compound statements formed by the connectives	Symbols used for connectives
and	conjunction	$\wedge$
or	disjunction	$\vee$
if .... then ....	implication (conditional)	$\Rightarrow$
if and only if	biconditional	$\Leftrightarrow$
not	negation	$\sim$

### Theorem

If “p” = there is suffering in life, “q” = there are causes of suffering in life, “r” = there is the cessation of suffering in life, and “s” = There is the noble eightfold path that ceases the suffering of life then, the relationship between these noble truths are as follows:

- 1)  $q \Leftrightarrow p$
- 1)  $q \Rightarrow p \Rightarrow p \wedge s \Rightarrow q$
- 1)  $q \Rightarrow p \Rightarrow p \wedge \sim s \Rightarrow q$
- 1)  $q \Rightarrow p \Rightarrow p \wedge s \Rightarrow r$

### Proof:

**Table 2:** Proof for the relationship between four noble truths.

S.N.	Statements	Reasons
1	p,q,r and s are true statements	Given
2	$q \Rightarrow p$	If there is a cause of suffering, then this will certainly lead to suffering in life. Suffering does not come from nowhere, it arises because of its own causes and conditions (Side, 1997, p.35).
3	$p \Rightarrow q$	If there is suffering in life then because of suffering, one goes to make many acts in his life. This very act of self- further leads to creating bases of new causes of suffering. According to Krishnamurti (1977), sorrow does not teach you wisdom, on the contrary, it makes you more self-protective, insensitive, and cunning.

4	$s \Rightarrow r$	If one follows the noble eightfold path, then one can end his/her suffering in life. Santina (1997, p.62) writes, the noble eightfold path is contemplated to cure the disease of suffering through ending its causes.
5	$p \Rightarrow p \wedge \sim s$	A suffering person knows the noble eightfold path but does not follow it. This is a possible truth for some people.
6	$p \Rightarrow p \wedge s$	A suffering person seeks a cure and follows the noble eightfold path. This is a possible truth for some people.
7	$p \wedge \sim s \Rightarrow q$	If a suffering person doesn't follow the noble eightfold path, then the person remains in the same vicious circle as the fourth noble truth suggests it is the only path of final liberation.
8	$p \wedge s \Rightarrow q$	Case I: If one is suffering and following eight noble paths then still there is the probability to return to the cause of suffering because the suffering person still has the desire to get rid of suffering. The observer (practitioner) is the system, the method, the result of all past experiences, knowledge, the routine, the mechanical process of repetition and therefore is the past. If anyone introduces a system, method, practice it is still within the same field of cause and effect (Krishnamurti, 2020).  People rarely realise non-suffering because it takes a special kind of willingness, ability, and practice (Sumedho, 1992, p.37).
9	$p \wedge s \Rightarrow r$	Case II: If there is suffering in life and one follows a noble eightfold path properly with the right (samyak) act, then one ends the suffering in life. Dhamma's teaching asserts that there is only one way to liberation but treading the path requires the right effort (Gordon et al., 2015).
10	$q \Leftrightarrow p$	From Statements 2 and 3
11	$q \Rightarrow p \Rightarrow p \wedge \sim s \Rightarrow q$	From statements 2,5 and 7
12	$q \Rightarrow p \Rightarrow p \wedge s \Rightarrow q$	From statements 2,6 and 8
13	$q \Rightarrow p \Rightarrow p \wedge s \Rightarrow r$	From statements 2,6 and 9

## Finding

The proof of the theorem has four major findings, they are

i)  $q \Leftrightarrow p$

The compound statement states that “ There is suffering in life if and only if there is cause of suffering in life.”

ii)  $q \Rightarrow p \Rightarrow p \wedge \sim s \Rightarrow q$

The compound statement states that “ Because of the cause of suffering, there is suffering in the life of a person, again if the suffering person does not follow the noble eightfold path then he/she returns to creating the cause of suffering.”

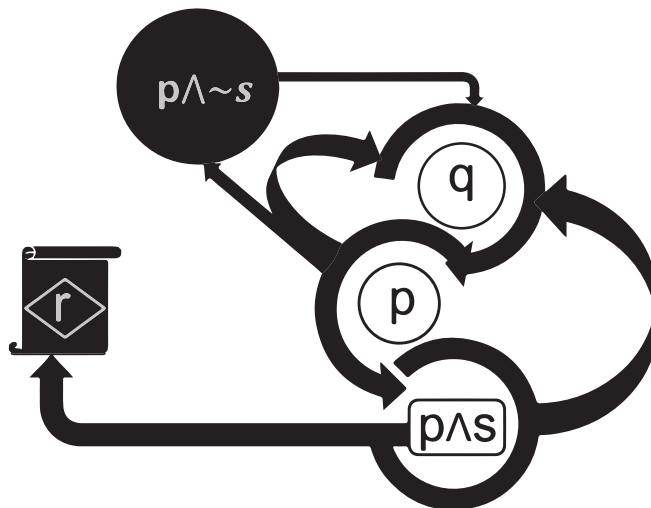
iii)  $q \Rightarrow p \Rightarrow p \wedge s \Rightarrow q$

The compound statement states that “ Because of the cause of suffering there is suffering in the life of a person, again if the suffering person further follows the noble eightfold path then he/she returns to the creating cause of suffering.”

iv)  $q \Rightarrow p \Rightarrow p \wedge s \Rightarrow r$

The compound statement states that “ Because of the cause of suffering there is suffering in the life of a person, again if the suffering person further follows the noble eightfold path then he/she ends the sorrow of life.”

### Process Flow Diagram of the relationship between four noble truths



**Figure 1:** Process flow diagram showing the relationship between four Noble Truths.

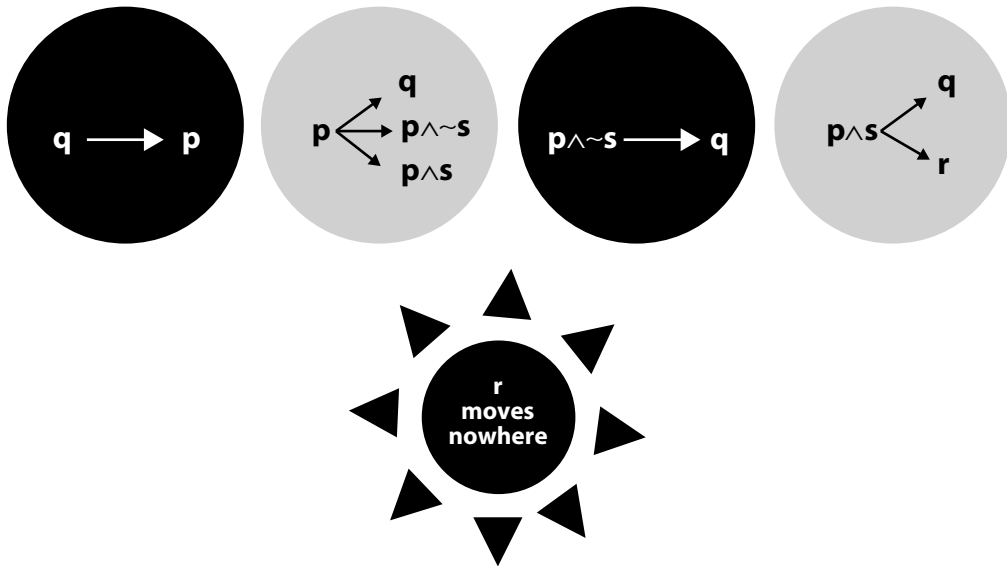
This process flow diagram includes all the four main findings in a single picture. In this diagram, we can move ahead from any point. Movement from every point towards the possible direction is shown in the diagram.



## Further Findings

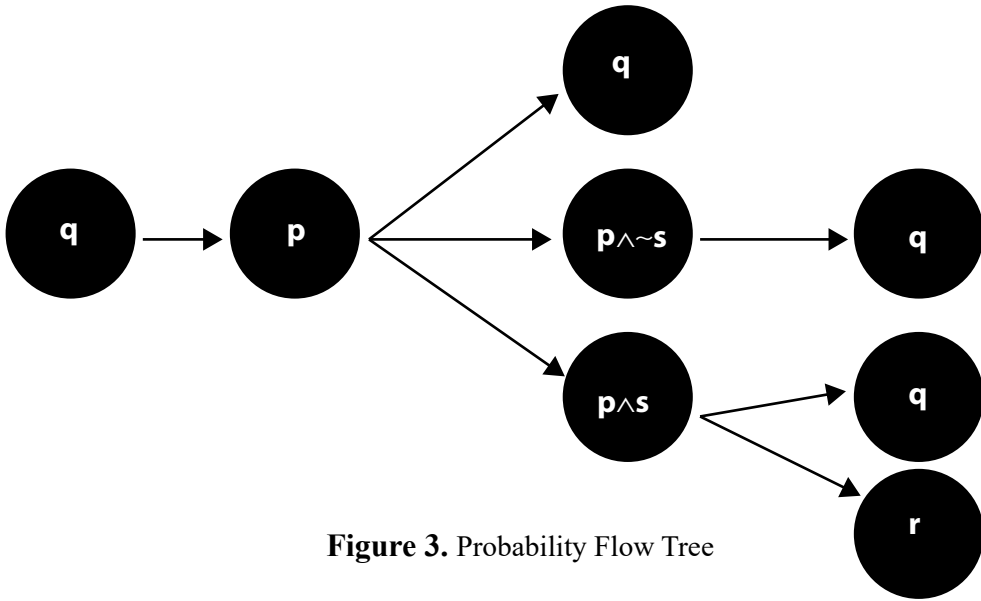
Furthermore, on analysing the results few more further findings can be pointed out as follows:

- a)  $q$  moves towards a single direction of  $p$ .
- b)  $p$  moves towards three possible directions of  $q$  or  $p \wedge \sim s$  or  $p \wedge s$ .
- c)  $p \wedge \sim s$  moves towards a single direction of  $q$ .
- d)  $p \wedge s$  moves towards two possible directions of  $q$  or  $r$ .
- e)  $r$  moves nowhere.



**Figure 2.** Further findings

## Probability Flow Tree of the relationship between four noble truths



**Figure 3.** Probability Flow Tree

## Discussion

The objective of this research article was to find a mathematical model that could interpret the interrelationship between four noble truths and to determine whether the fourth noble truth is still in the domain of cause and effect relationships with the first and second noble truth (pre-mentioned in research questions RQ1 and RQ2). To perform this work conditional relation, and biconditional relation was used. The main finding of the research was  $q \Leftrightarrow p$ ,  $q \Rightarrow p \Rightarrow p \sim s \Rightarrow q$ ,  $q \Rightarrow p \Rightarrow p \wedge s \Rightarrow q$  and  $q \Rightarrow p \Rightarrow p \wedge s \Rightarrow r$  where “ $p$ ” is a coded form of the statement “there is suffering in life”, similarly, “ $q$ ”: “there is the cause of suffering”, “ $r$ ”: “there is the end of suffering”, and “ $s$ ”: “there is a way of the noble eightfold path to end the suffering”.

The first result  $q \Leftrightarrow p$  elaborates that causes of suffering and suffering are cyclically related. One can't precisely distinguish when one starts and the other ends. But still, they both are the cause of the rebirth of one another. In Buddhism, this cycle is called samsara: the ignorance about self. The root cause of our unenlightened existence within this cycle of rebirths, samsara in Sanskrit is said to be our fundamental ignorance: our grasping at a sense of self (Dalai Lama XIV Bstan-'dzin-rgya-mtsho, 2011, p.22). Additionally, the Dalai Lama adds our afflictive mental attitudes like craving, aversion, pride, and jealousy condition our mind into the unenlightened existence of samsara.

The second result  $q \Rightarrow p \Rightarrow p \sim s \Rightarrow q$  is very obvious and resembles the first result of  $q \Leftrightarrow p$ . Many people in the world are suffering but they don't follow the path to end their suffering (noble eightfold path) due to many obvious and hidden reasons. This relation shows there is no way out without following the noble eightfold path. The person who is not following the noble eightfold path will always be a part of the game of samsara; the cycle of rebirth. The third result  $q \Rightarrow p \Rightarrow p \wedge s \Rightarrow q$  is again a vicious circle of cause and effect, the cycle of death and rebirth, the dilemma of samsara. This model explains a person who is following the way of the noble eightfold path but still entwining around the same circumference. This relation asserts that just following the noble eightfold path is not enough; rather the wish and will that is behind the following noble eightfold path gives birth to new karma. Moreover, Penguin classics (2010) also explains in the Dhammapada, - “Fore-run

by the mind are mental states, ruled by the mind, made of mind. If you speak or act with a corrupt mind, suffering follows you, as in the wheel of the foot of the ox.”

The third result answers our second research question (RQ2) of “Does the fourth noble truth have any relationship with the first and second noble truths?” Taking into consideration, what Santina has mentioned (as discussed in the introduction part) and in the introduction part of the book *The Vision of Dhamma*, Bhikkhu Bodhi mentioned (Thera, 1994, p.xxiv) - In the domain of cause-and-effect good actions always lead to a higher form of rebirth whereas bad actions lead to lower forms of rebirth. We see that the cyclic movement of the vicious circle of cause-and-effect is not only two-dimensional but it also moves upward and downward. No matter moving upward or downward they are still just movements of samsara thus, a person following the noble eightfold path is still in the domain of cause-and-effect as our result directs.

The fourth result:  $q \Rightarrow p \Rightarrow p \wedge s \Rightarrow r$  reveals the only possibility of getting out of the realm of rebirth, the complete liberation. In this possibility, there is no return back to the vicious circle. Nevertheless, the final result “r” has its background causes and is visualised as a product, many Buddhist scholars believe that this result “r” is not a byproduct of any causes; rather when all the causes and suffering are ceased then, it is left as a result. In the fourth noble truth, the cause is absence: in other words, when the causes of suffering are removed, the absence of such causes is the cause of the cessation of suffering (Santina, 1997, p.46). This result shows the most significant part of Buddhist teaching as all the teachings and practices in Buddhism revolve around this fulcrum. Lord Buddha has assured that there is complete cessation of suffering and that is when all the causes of suffering are removed. If we understand properly that any effort to eliminate the cause of suffering will again produce a new ripple of the circle into the pond of samsara, it is tricky, puzzling, and needs proper practising of a noble eightfold path in the level of higher understanding to overcome the situation. The results  $p \wedge s \Rightarrow q$  and  $p \wedge s \Rightarrow r$  led us to think rationally that there is a vast difference in dealing with noble eightfold path (s). One can lead a person back to a vicious circle and another can throw him out of the circular wheel.

Further findings elaborate about the definitive and probabilistic nature of the association of the term, used in the four results of findings, with other terms. In the first further finding (a), “q” moves towards a single direction of p show the cause of suffering only leads to suffering in life, and similarly the third further finding (c)  $p \wedge \sim s$  moves towards a single direction of “q” states, when a suffering person does not follow noble eightfold path, the person again gets stuck within the same vicious circle. In the second further finding (b), “p” moves towards three possible directions of “q” or  $p \wedge \sim s$  or  $p \wedge s$  shows the probabilistic nature of the movement of “p” towards three possible directions and in the fourth further finding (d)  $p \wedge s$  moves towards two possible directions of q or r again shows the probabilistic nature of the movement of  $p \wedge s$  towards two possible directions of “q” or “r”. Though these further findings of the second (b) and the fourth (d), do not reveal how much percentage of probability is there for a particular directional movement. “r” is the only term that moves nowhere further. This position of “r” is a highly desirable and fascinating aspiration of followers of Buddhism. Since this is the ultimate goal of followers and the final destination described by Buddha himself, “r” has the greatest significance in a follower’s life.

All these four main findings give answers to the first research question of RQ1. This research will help readers to understand the interrelationship between four noble truths and will give an idea to formulate the relationship between existing theories with each other. The research is limited to the domain of existing knowledge in the literature of Buddhism. Reasons for any effect are mostly driven by the field of Buddhist literature. In the different fields of the domain, results may vary

differently but the procedure forwarding using connectives will remain the same. However, the implication of findings of this research has wide scope as developing theory for future research. For further study, there are four possible major areas:

1. In the relation of  $q \Leftrightarrow p$ , and  $q \Rightarrow p \Rightarrow p \sim s \Rightarrow q$  future researchers can establish the relationship between cause and effect and show a downward spiral movement regarding the theory that bad actions lead to lower forms of rebirth.
1. In the relation of,  $q \Rightarrow p \Rightarrow p \sim s \Rightarrow q$ , and  $q \Rightarrow p \Rightarrow p \sim s \Rightarrow r$  future researchers can establish the cause and effect relationship to show an upward spiral movement regarding the theory that good actions lead to a higher form of rebirth.
2. In the deductive study of the probabilistic nature of the relationship between the four noble truths.
1. The third finding can further be investigated in well-performed research. This could be interesting research for future studies as the result ( $q \Rightarrow p \Rightarrow p \sim s \Rightarrow q$ ) behaves in a circular pattern apart from the linear way of reaching the ultimate absolute variable “r”.

## Conclusion

The main purpose of this research was to adequately investigate the interrelationship between four noble truths qualitatively using mathematical models, and how the fourth noble truth is functionally related to the realm of the rebirth of cause-and-effect. The investigation was undertaken with the help of specific research questions (see chapter introduction), which was predominantly focused on the interrelationship between four noble truths and specifically understanding the causal relationship of the fourth noble truth with the second one. The results were obtained by carefully analysing the four noble truths in terms of four specific separate variables using a cause-and-effect relationship and a mathematical model. The data (four considered variables) were processed for extracting the information required for answering both research questions regarding this research.

The literature review and results from the interpretation of four variables interpret that the four noble truths represent not merely fundamental messages of Buddhism, but they remain facts of our life. The first two parts are always there in everyone’s life as samsara, whereas the addition of the fourth truth of the noble eightfold path is carried simultaneously with the first two parts by the disciples or followers of Buddhism. Some of them with core understanding and right practising of fourth noble truths may come out of the realm of death and rebirth. For such a person there is no return to the vicious circle of cause-and-effect. One different result among the findings is that followers or disciples following noble eightfold path will be still inside the vicious circle unless getting final enlightenment: that is causeless, reasonless, and not a byproduct of any act of self. This research paper is advantageous in the sense that it presents the relationship between four variables of noble truths together with cause-and-effect clauses in a pattern shown by a mathematical model. This mathematical model will convey readers a quick understanding of the possible relationships between four noble truths. Moreover, the four major findings from this research work can be used by future researchers to develop their literature as well as theory.

The limitation of this research is, to justify the movement of cause and effect, which is driven from the domain of Buddhist literature and to some extent externally. If we justify the linkage of if and then the relation between two different propositions into a new domain (other than Buddhism literature), the results may occur differently. The study does not incorporate any pure mathematical

derivation or formulas for assessing the relationship between four variables. However, the study was performed using tools like conditional, and biconditional to typically find the interrelationship between the considered variables as the mathematical models can exactly represent the real problem situations (Klamkin, 1987). Although the study provides a mathematical model for the connection of four noble truths, developing an in-depth understanding of these relationships will require further investigation.

In future research, it would also be interesting to study how downward spiral movement (see figure 1 and end section of discussion chapter to relate the context) relates to the theory that bad actions lead to lower forms of rebirth and how upward spiral movement (see figure 1 and end section of discussion chapter to relate the context) relates to the theory that good actions lead to higher forms of rebirth. Furthermore, a deductive study on the probabilistic nature of relationship between four noble truths is another possibility

## References

- Anderson, C., & Anderson, C. S. (1999). *Pain and its ending: the Four Noble Truths in the Theravāda Buddhist canon*. Curzon.
- Christensen, L., & Johnson, R. B. (2013). *Educational Research: Quantitative, Qualitative, and Mixed Approaches*. SAGE Publications.
- Dalai Lama XIV Bstan-'dzin-rgya-mtsho. (2011). *A Profound Mind: Cultivating Wisdom in Everyday Life* (N. Vreeland, Ed.). Harmony Books.
- Gethin, R. (1998). *The foundations of Buddhism*. OUP Oxford.
- Gordon, W. V., Shonin, E., Griffiths, M. D., & Singh, N. N. (2015). Mindfulness and the Four Noble Truths. In (pp. 9 - 25). Springer International Publishing Switzerland.
- Hanh, T. N. (2008). *The Heart Of Buddha's Teaching*. Ebury Publishing.\
- Howson, C. (1997). *Logic with Trees: An Introduction to Symbolic Logic*. Routledge.
- Klamkin, M. S. (1987). *Mathematical Modeling: Classroom Notes in Applied Mathematics*. Society for Industrial and Applied Mathematics.
- Klenk, V. (2008). *Understanding Symbolic Logic*. Pearson Prentice Hall.
- Krishnamurti, J. (1977). *The Urgency of Change* (M. Lutyens, Ed.). Perennial Library.
- Krishnamurti, J. (2020). *The Way of Intelligence*. Krishnamurti Foundation Trust.

- Leavy, P. (2017). *Research Design: Quantitative, Qualitative, Mixed Methods, Arts-Based, and Community-Based Participatory Research Approaches*. Guilford Publications.
- Mahathera, V. N. (2010). *THE BUDDHA AND HIS TEACHINGS* (Third ed.). Buddhist Publication Society, Kandy, Sri Lanka.
- Merriam, S. B. (2009). *Qualitative research: a guide to design and implementation*. Wiley.
- Nhật Hạnh. (1991). *Old path, white clouds: walking in the footsteps of the Buddha*. Parallax Press.
- Penguin Classics, P. (2010). *The Dhammapada* (V. Roebuck, Ed.; V. Roebuck, Trans.). Penguin Books Limited.
- Santina, D. P. D. (1997). *The Tree of Enlightenment*. Buddha Dharma Education Association Inc.
- \Saunders, M., Lewis, P., & Thornhill, A. (2016). *Research Methods for Business Students* (Seventh ed.). Pearson Education.
- Side, D. (Ed.). (1997). *The Four Noble Truths: Fundamentals of Buddhist Teachings*. Thorsons.
- Sumedho, A. (1992). *The Four Noble Truths*. Buddha Dharma Education Association Inc.
- Thera, N. (1994). *The Vision of Dhamma* (B. Bodhi, Ed.; Second ed.). Pariyatti Publishing, Onalaska, USA.
- TSERING, G. T. (2005). *The Four Noble Truths: The Foundation of Buddhist Thought* (L. Z. RINPOCHE & G. MCDOUGALL, Eds.; Vol. One). Wisdom Publication, Boston.

## Contributor

Mr. Basnet teaches at Rupandehi Campus. His interesting subject is mathematics. His main areas of interest includes research and training.