

**THE BALI WARIGA CALCULATION SYSTEM: AN
ANALYSIS OF SEASON DETERMINATION IN
ASTRONOMIC PERSPECTIVE**

UNDERGRADUATE THESIS

Submitted to Faculty of Syariah and Law in Partial of the
Requirement for the Degree of Bachelor of Law in Department of
Islamic Astronomy



Written by:

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**FACULTY OF SYARIAH AND LAW
STATE ISLAMIC UNIVERSITY OF WALISONGO
SEMARANG
2021**

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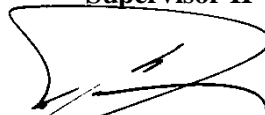
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RATIFICATION



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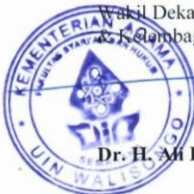
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MOTTO

تَبَارَكَ الَّذِي جَعَلَ فِي السَّمَاءِ بُرُوجًا وَجَعَلَ فِيهَا سِرَاجًا وَقَمَرًا مُنِيرًا
(الفرقان: ٦١)

“Blessed be He who has set in heaven constellations, and has set among them a lamp (sun), and an illuminating moon”

(Q. S. *Al-Furqan* : 61)¹

¹ Abdullah Yusuf Ali, *The Holy Quran English Translation of the Meaning and Commentary*, (Medina, Saudi Arabia: King Fahd Printing Complex, 1991), 548.

DEDICATION

All the praises and thanks be to Allah SWT, the lord of the world

This thesis is dedicated to:

A special feeling of gratitude to my loving parents, Mr. Sugito and Mrs. Hosniyah for their love, pray, endless support, and words of encouragement and push for tenacity ring in my ears.

My beloved brother and sister; Anna Putri Hasanah, Aynun Fadilla, Hakiki Rahman Halim and Muhammad Habibi Al-Furqany, thank you for the laughter and happiness you all have given to me through this process.

My thesis supervisors; Dr. H. Ahmad Izzuddin, M. Ag. and Moh. Khasan, M. Ag, who were more than generous with their expertise and precious time for guide me in this work,

My Semarang's Family in Life Skill Daarun Najaah Semarang Islamic Boarding School and GEMAWA 11

Those people who appreciate and encourages this undergraduate thesis

DECLARATION

With full honesty and responsibility, the author states that this work does not contain material that has been written by someone else or published. Likewise, this work does not contain any other people's thoughts, except the information contained in the references that are used as reference material.

Semarang, June 19th 2021

Declarator



[Handwritten Signature]
Ayu Fitri Damayanti

1702046094

TRANSLITERATION²

I. Single Consonant

Letter	Name	Romani zation	Letter	Name	Romani zation
ء	hamzah	ʾ	ظ	ẓāʾ	ẓ
ا	alif	ā	ع	ʿayn	ʿ
ب	bāʾ	b	غ	ghayn	gh (gh)
ت	tāʾ	t	ف	fāʾ	f
ث	thāʾ	th (th)	ق	qāf	q
ج	jīm	j	ك	kāf	k
ح	ḥāʾ	ḥ	ل	lām	l
خ	khāʾ	kh (kh)	م	mīm	m
د	dāl	d	ن	nūn	n
ذ	dhāl	dh (dh)	ه	hāʾ	h
ر	rāʾ	r	و	wāw	w; ū
ز	zayn/zāy	z	ي	yāʾ	y; ī
س	sīn	s	أ	alif maddah	ā, ʾā
ش	shīn	sh (sh)	ة	tāʾ marbūṭ ah	h; t
ص	ṣād	ṣ	ال	alif lām	al-
ض	ḍād	ḍ	ى	alif maṣṣūrah	á
ط	ṭāʾ	ṭ			

² This undergraduate thesis is using ALA-LC (American Library Association – Library of Congress) romanization, which is used internationally in scientific publication by Arabist.

II. Double Consonant

Double consonant, including syaddah, is written in double. For example:

رَبَّكَ is written rabbaka

الْحَدَّ is written al-haddu

III. Vowel

1. Short vowel

Vowel or *harakat fathah* is written as *a*, *kasrah* as *I*, and *dammah* as *u*.

2. Long vowel

Long vowel (māddah), which in arabic uses *harakat* and *hurûf*, is written as *hurûf* and *stipe* (-) above it: ā, ī, ū. For example:

قَالَ is written as *qāla*

سَا نَتِّيرْ سِي is written as *qāla*

يَا قَوْلِ is written as *yaqūlu*

3. Double vowel

- *Fathah+ya' sukun* is written ai

For example: كَيْفِ is written as *kaifa*

- *Fathah+wawu sukun* is written as au

For example: حَوْلِ is written as *haulau*

IV. Ta' Marbūṭah (ة) in the End of Word

1. Ta' Marbūṭah (ة) in the end of word with sukūn is written as h, except Arabic word that is used as Indonesian word, such as salat, zakat, tobat, etc. For example:

haḥlaṭ sa nettirw si ط لحة

التوبة is written as al-taubah

2. Ta' Marbūṭah (ة) that is followed by (ال) if they are separated or read as sukun, it must be written as h. For example:

روضه الأطفال is written as rauḍah al-aṭfāl

But if they are read a unit, it must be written as t. For example:

روضه الأطفال is written as rauḍatul aṭfāl

V. Article Alif +Lam

1. Article (ال) that is followed by *hurūf shamsiyah* is written as how it is read and separated by stripe (-). For example:

sa nettirw si رحيم ar-Raḥīmu

السيد is written as as-sayyidu

الشمس is written as asy-shamsu

2. Article (ال) that is followed by *hurūf qamariyah* is written as al and separated by stripe (-). For example:

sa nettirw si ملك al-Maliku

sa nettirw si كافرون al-kāfirūn

VI. Word as Part of Phrase or Sentence

1. If the structure or words does not change the way to read it, it is then separately each word, or
2. If the structure of words changes the way to read it and unites them, then it must be written as the way it is read, or separated in the structure. For example:

خير أَلرَازِقِينَ is written as *khair rāziqīn* or *khairurrāziqīn*.

ABSTRACT

The Bali *Wariga* is one of the traditional time reckoning in Indonesia that used for determining the good or bad time for daily activity, such as determining time of season. The season is divided into 12 months, which is adjusted to the tropical season system, the dry and rainy seasons. This research discuss about how the Bali *Wariga* season system in the light of astronomical studies, in accordance with the current scientific progress.

Departing from the knowledge of the *Wariga*, can be seen the reflection of ancient cultural wealth can still be attached to today's society. Binding to culture, not narrowing the use of *Wariga* only to the regional scope. Therefore, Bali *Wariga* as a local genius of the Nusantara certainly needs to be preserved and can be explored further so it can be proven scientifically.

This research is a type of qualitative research with a literature research study (library research). The data collection method are the documentation, containing data about seasonal system of *Wariga* and also interviews method adressed to *Wariga* experts. The data obtained are analyzed descriptively, describing the Bali *Wariga* season system based on existing theories.

This study result in two findings. First, from the analysis of astronomical perspective, in line with the time theory called *Kala* contain the appearance of the sun (*Uttarayana* and *Dhaksinayana*) and the appearance of the Orion constellation used for determining season in *Wariga*. Second, the analysis is carried out on the accuracy test for the beginning of season using 3 references, the annual motion of the sun, the appearance of star, and the climatological reference using seasonal data issued by the Meteorology, Climatology and Geophysics Agency or BMKG. The result obtained is that the beginning of the Bali *Wariga* season is in line with these three references result.

Keyword: Season, Bali Wariga, Traditional Time Reckoning, Astronomy.

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Because of the blessing and graces of Allah and fighting spirit which exemplified by Prophet Muhammad, with thankfully the author finished this undergraduate thesis with title “The Bali *Wariga* Calculation System: An Analysis Of Season Determination In Astronomic Perspective”. Thanks, outgiving never ended presented for those who have supported and guided in completing this undergraduate thesis.

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Semarang, June 19th 2021



Ayu Fitri Damayanti

170204094

TABLE OF CONTENTS

PAGE OF TITLE	i
SUPERVISOR APPROVAL	ii
SUPERVISOR APPROVAL	iii
RATIFICATION	Error! Bookmark not defined.
MOTTO	v
DEDICATION	vi
DECLARATION	vii
TRANSLITERATION	viii
ABSTRACT	xii
ACKNOWLEDGEMENT	xiii
TABLE OF CONTENTS	xvi
LIST OF TABLES	xix
LIST OF FIGURES	xx
CHAPTER I INTRODUCTION	21
A. Background of Study	21
B. Research Question	26
C. Purpose of Research.....	26
D. Significance of Study	26
E. Literature Review	27
F. Research Methodology.....	29
G. Systematic of Writing	32
CHAPTER II THE SEASON AND TIME RECKONING	34
A. Understanding The Season	34

1.	Definition of Season	34
2.	The Causes of Season on Earth	35
3.	Season on Earth.....	39
4.	Season in Indonesia	41
B.	The Time Reckoning.....	46
1.	Modern Time Reckoning	46
2.	Traditional Time Reckoning	47
3.	World Calendar System	49
CHAPTER III THE BALI WARIGA AND ITS SEASONAL SYSTEM		59
A.	Balinese Calendar	59
B.	Understanding The <i>Wariga</i>	60
1.	The Definition of <i>Wariga</i>	60
2.	The History of <i>Wariga</i> in Bali.....	62
3.	Basic Knowledges of <i>Wariga</i>	64
4.	The Bali <i>Wariga</i> Seasonal System.....	75
CHAPTER IVTHE ANALYSIS OF SEASONAL SYSTEM OF BALI WARIGA		84
A.	Analysis of Seasonal Determination System of Bali <i>Wariga</i> in Astronomic Perspective	84
1.	Sun	84
2.	Constellation	87
B.	The Accuration of Beginning Season in Bali <i>Wariga</i>	92
1.	Sun Motion's Reference	92
2.	Star Reference	93

3. BMKG Reference	94
CHAPTER V CONCLUSION AND RECOMMENDATION	99
A. Conclusion.....	99
B. Recommendation	99
BIBLIOGRAPHY	101
ATTACHMENT	110
CURRICULUM VITAE.....	118

LIST OF TABLES

Table 2.1 Perihelion, Aphelion, Equinox, and Solstice Data for 2014-2024	38
Table 2.2 Seasonal Cahnge on Earth in Common	40
Table 2.3 Indian Six-Season Method.....	41
Table 3.1 The Numbering of <i>Wuku</i> and <i>Neptu</i>	66
Table 3.2 The Numbering of <i>Wewaran</i> and <i>Neptu</i>	69
Table 3.3 The Panca Dauh and Hour in WITA	74
Table 3.4 The Asta Dauh and Hour in WITA	74
Table 3.5 Month in <i>Wariga</i> and Gregorian	76
Table 3.6 Orion Appearance Data of Bali <i>Wariga</i>	83
Table 4.1 The Accuration of Orion’s Appearance Using Stellarium Reference.....	90
Table 4.2 Month in <i>Wariga</i> and Gregorian year 2021	91

LIST OF FIGURES

Figure 2.1 Earth's Axial Tilt	35
Figure 2.2 Reflection of The Earth Orbit Around The Earth	36
Figure 3.1 Illustration of Moon Phase	72
Figure 3.2 Interpretation of Season Based on Uttarayana and Dakshinayana	81
Figure 4.1 Annual Motion of Earth.....	85
Figure 4.2 <i>Waluku</i> (Orion), The Plow.....	88
Figure 4.3 The Belt Star of Orion	89
Figure 4.4 Data of Rise, Transit and Set of Mintaka	94
Figure 4.5 Forecast of 2021 Dry Season by BMKG.....	96
Figure 4.6 Forecast of 2021 Rainy Season by BMKG.....	97

CHAPTER I

INTRODUCTION

A. Background of Study

Time is very influential for every human life. Time is marked by natural phenomena, such as the regular appearance of the Sun. This is the simplest basis for the purpose of measuring time. The rising of the Sun from the eastern horizon marks the beginning of day, while its setting marks the night. The events of day and night mark periods of time, days, even years.³ This infinite length of time is beyond human control. Humans are a speck of age that will disappear from history to history, and time will continue to run.

Humans all times walk in time on Earth according to the rotation of the Earth and other solar systems. The solar system consisting of eight planets, moons, comets (asteroids) is often called the body or members of celestial bodies, where all celestial bodies move statically and dynamically and go according to their respective orbits.⁴ The changing colors of the sky, the alternation between night and day, different weather patterns and seasons, eclipses, the appearance and

³ Daniel V. Schroeder, “The Sun and the Seasons” in *Understanding Astronomy* (Department of Physics, Weber State University Utah: 2011) as quoted in <https://physics.weber.edu/schroeder/ua/SunAndSeasons.html>, retrieved 11 March 2021.

⁴ Ahmad Izzuddin, *Ilmu Falak Praktis*, (Semarang : PT Pustaka Rizki Putra, 2012), 1.

disappearance of the sun, moon, and stars, all contribute to the interest, awe, and attraction humans feel for the sky and sky-related phenomena.⁵ The understanding of night and day proves that all of these have been determined, arranged and adjusted to their respective positions, as contained in Qur'an Surah Yunus verse 6:

إِنَّ فِي اخْتِلَافِ اللَّيْلِ وَالنَّهَارِ وَمَا خَلَقَ اللَّهُ فِي السَّمَوَاتِ وَالْأَرْضِ لَآيَاتٍ
لِّقَوْمٍ يَتَّقُونَ

“Indeed, in the exchange of night and day and what Allah created in the heavens and on earth, there are signs (of His power) for those who fear.” (QS. Yunus : 6)⁶

The origin of astronomy goes back to prehistoric times from which no records have survived. At the dawn of history we find indications in the oldest written records that astronomical phenomena had already captured man's attention, just as we found today among people a certain knowledge of stars and of heavenly phenomena.⁷

⁵ Encyclopedia, “Sky Heaven As Hierophany” in *Encyclopedias almanacs transcripts and maps* as quoted in <https://www.encyclopedia.com/environment/encyclopedias-almanacs-transcripts-and-maps/sky-heavens-hierophany>, retrieved 13 March 2021.

⁶ Kemenag RI, *Al-Qur'an dan Tafsirnya*, (Jakarta: PT . Sinergi Pustaka Indonesia, 2012), 257.

⁷ Anton Pannekoek, *A History of Astronomy*, (New York : Dover Publications, Inc.), 19.

Departing from an understanding of the regularity of the Sun's appearance on the celestial sphere combined with the rhythm of biotic natural breaths in response to exposure to heat radiation from the closest star to Earth, the people of the Nusantara who live between Mount Merapi and Merbabu once knew *Pranatamangsa* as their guide in farming.⁸ In West Kalimantan, the Dayak tribe has the introduction of a special traditional time as a guide to farming so it is also known as the "*Bulan Berladang*" or Farming Month. By using this Farming Month guideline, it turns out that plants often do well.⁹ In North Sumatra, the Batak tribe knows "*Perhalaan*" which among other things provides guidelines for a good time to sow seeds, a good time to receive livestock as a wedding gift, and so on.¹⁰ In Bali, it is known as "*Wariga*"¹¹ which is a collection of good or bad days to start a ceremony or a job or to determine the season.

The time reckoning system in Indonesia, which is divided into several islands with a variety of ethnicities, races, and cultures, has made the calendar system unique,

⁸ Muh. Hadi Bashori, *Penanggalan Islam : Peradaban Tanpa Penanggalan, Inikah Pilihan Kita*, (Jakarta: PT Elex Media Komputindo, 2013), 237.

⁹ J. U Lontaan, *Sejarah Hukum Adat-Istiadat Kalimantan Barat*, (Pemda Kalimantan Barat, 1975), 32.

¹⁰ Batara Sangti Simanjuntak, *Sejarah Batak*, (Medan: K. Sianipar Company, 1978), 67.

¹¹ Simpen, *Pelajaran Dewasa (Wariga)*, (Denpasar : Toko Buku Muria, 1987), 35.

special, and influential in the lives of previous societies¹². Natural signs can describe an event of how nature arranges itself in the all-round cosmic circle regular. That's where the laws of nature actually signal to human about how to treat nature and the environment. For the Balinese, signs manifested in constellations, climate, wind, and animal behavior is a natural law as a sign or a marker for committing a certain action. There is a connection, *Wariga* it's not just a classic timing use natural law system but in reality contains astronomy which is developing in a contemporary manner.

Wariga is a traditional time reckoning used by Balinese people to recognize time to combining astronomy and mathematics. The knowledge of *Wariga* in Sanskrit it is called knowledge of *Dewasa* (*Dewa* = Soul = Light = Ray = *Teja*). *Dewasa* is defined as the influence of light from celestial bodies, especially the stars and the sun, on the life of creatures on earth.

The mathematical concept used in *Wariga* is the *Shulbasutra*¹³ concept which contains mathematical formulas to design various altar buildings for shrines in rituals that

¹² Hikmatul Adhiyah Syam, The Essentiality Of The Nusantara Traditional Calendar, *Al-walrev: Journal of Islamic Astronomy*, Vol. 3, No. 1, (2021), 2.

¹³ In *Shulbasutra* there are decimal numbers of tens, hundreds, and procedures from the remaining addition of the previous numbers from one column of numbers to another column of numbers, there is also a way of dividing and using certain signs to determine equations and some letters to show unknown factors. Read on Navaratna Srinivasa Rajaram, *Vedic Aryan and The Origin of Civilization*, (India : The Voice of India, 1995), 159.

have existed in India since the Mahabharata war. This concept is recorded and summarized in the Vedas which is a sacred mathematical concept. Since then *Wariga* has been widely used for all Hindu community activities in Bali. From this calculation basis, *Wariga* was born as a guide in determining the right time to start all activities.

In this case, the Balinese people take advantage of the calculations contained in *Wariga* and apply it to their daily lives, one of which is to predict when the season will occur for farming and sailing activities. Due to the importance of *Wariga's* influence in all Balinese activities, it is possible to understand that *Wariga* is a cultural product that is very important to be preserved and in its consistency requires scientific proof.

On this basis, the author wants to research the study of *Wariga* in astronomic perspective, due the fact that there has been no academic study on this subject. In the other hand, this research aims to add to the treasures of Islamic Astronomy in the field of traditional calendar and preserving culture while fulfilling the author's obligations as academics. Therefore, the authors would to raise this discussion for the purpose of an academic research entitled “THE BALI WARIGA CALCULATION SYSTEM : ANALYSIS OF SEASON DETERMINATION IN ASTRONOMIC PERSPECTIVE.”

B. Research Question

To make the problems more specific and following the study's emphasis points, there must be a formulation of the issues that are the focus of this study. Can be taken several problem formulations from the background above :

1. How is the analysis of the seasonal system of Bali *Wariga* in astronomical perspective?
2. How is the accuracy of the beginning of the season on the Bali *Wariga* system?

C. Purpose of Research

The objectives to be achieved in writing this proposal are :

1. Analyze the traditional *Wariga* time calculation system in determining seasons based on astronomic perspective.
2. Knowing the accuracy of the data at the beginning of the month of the *Wariga* season

D. Significance Of Research

1. In addition to the scientific treasures of Indonesia Islamic Astronomy, especially in the study of the local calendar as a legacy of the ancestors of the Indonesian nation.
2. As a new study and a concern regarding cultural-astronomical form for public.
3. As a scientific paper which can be used as information and source of reference for the future researchers.

E. Literature Review

To meet the requirements for the purpose of writing scientific papers, the authors use references from literature related to the problem. The literature review was carried out to obtain an overview of the correlation between this study and previous research. Based on the author's research on scientific works such as undergraduated theses, theses, and dissertations that discuss *Wariga*, especially those discussing the determination of seasons, there has not been any writing that specifically discusses the analysis of seasonal forecasts in the *Wariga* Bali calculation system from an astronomical perspective. However, in the event that related to the relevance of this research, there are books or research papers, which are as follows:

Sukardi Wisnubroto's research in the journal *Agromet* entitled "The Meteorological Meaning of Traditional Time Reckoning *Wariga* and Its Application", which discusses the evidence and explanation of *Wariga*'s existence as a guide for various activities in Bali. And also discussed the relationship between *Wariga* in the Meteorological approach.¹⁴

Asthadi Mahendra Bhandes's research in the International Journal of Hindu Science and Religious Studies entitled "The Implementation Of The *Wariga Dewasa* On

¹⁴ Sukardi Wisnubroto, "Pengenalan Waktu Tradisional *Wariga* Menurut Jabaran Meteorologi dan Pemanfaatannya", *Jurnal Agromet*, vol. 13, no. 1 (1998); Universitas Gajah Mada, 15-24.

Panca Yajña Ceremony In Mataram City".¹⁵ This study discusses *Wariga* and its implementation in determining ceremonial times in the Mataram area.

Muhammad Awaludin's research was in the form of a thesis with the title "Rowot Sasak's calendar season system from an astronomical perspective: a case study in Kidang Village, Central Lombok".¹⁶ This thesis focuses on the discussion on Rowot's calendar season system from an astronomic perspective.

Then Isniyatin Faizah's Thesis¹⁷ "A Comparative Study of the Javanese Calendar of Prey Institutions and the Syamsiah Calendar System Associated with the Seasons." The Pranata Mangsa Javanese calendar is a calendar that is based on the circulation of the Sun and the circulation of the constellation Orion. Thus, the Javanese calendar of prey institutions have the ability to also be seen as an orionic calendar due the fact that the presence of the Orion Star, which according to the agrarian society is seen as a guardian/plow, plays a more important role in society.

¹⁵ Asthadi Mahendra Bhandes, "The Implementation Of The *Wariga* Dewasa On Panca Yajña Ceremony In Mataram City", *International Journal of Hindu Science an Religious Studies*, vol. 3 (2) (October 2019); STAHN Gde Pudja Mataram.

¹⁶ Muhammad Awaludin, "Sistem Musim Kalender Rowot Sasak Perspektif Astronomi : Studi Kasus di Desa Kidang Lombok Tengah", *Tesis*, Pascasarjana UIN Walisongo Semarang (Semarang, 2017).

¹⁷ Isniyatin Faizah, "Studi Komparatif Sistem Penanggalan Jawa Pranata Mangsa dan Sistem Penanggalan Syamsiah yang Berkaitan dengan Sistem Musim", *Skripsi*, Fakultas Syari'ah dan Hukum UIN Walisongo Semarang (Semarang, 2014).

Janatun Firdaus's thesis entitled "analysis of the Sundanese calendar in an astronomical review"¹⁸ deals with the calendar that uses the stars. This thesis explains that there is a Sundanese calendar called Sukra Kala which uses the constellations in determining matters related to agriculture and navigation.

From some of the papers above, it appears that the discussion of *Wariga* analysis in determining the season for the purpose of an astronomical perspective has never been done. This will be the focus of the research that the authors do next.

F. Research Metodology

1. The Type of Research

Research is an effort in the field of science that is carried out to obtain facts and principles patiently, carefully, and systematically to realize the truth.¹⁹ This type of research used in this research is qualitative research. Due the fact that this research is holistic (comprehensive), complex, dynamic, and full of meaning, so data in such situations cannot be carried out with

¹⁸ Janatun Firdaus, "Analisis Penanggalan Sunda dalam Tinjauan Astronomi", *Skripsi*, Fakultas Syariah IAIN Walisongo Semarang (Semarang, 2013)

¹⁹ Mardalis, *Metode Penelitian, Suatu Pendekatan Proposal*, (Jakarta : Bumi Aksara, 2010), 24.

quantitative research using instruments such as tests, questionnaires, or something else.²⁰

2. Resources

Sources of data used in this study are divided into two, namely primary and secondary data sources. Then the resource used are as follows :

a) Primary Sources

Primary data is data that is directly collected by researchers from its first source. The author uses this type of qualitative research which focuses on the object of research, *Wariga*. This way verbally describe the object of research in the form of systematic, factual, and accurate descriptions that come from relevant sources such as data of seasonal system of *Wariga* taken from Balinese calendar and a book entitled "*Dasar Wariga*" by Ida Bagus Putra Manik Aryana.

b) Secondary Sources

The author uses supporting data sources (secondary sources) which relate indirectly to the object of research, such as results of interview and *Wariga* literature such as history, calculation methods, and astronomical studies of *Wariga*. These data include information obtained from the results of interviews

²⁰ Sugiyono. *Metode Penelitian Kuantitatif, Kualitatif dan R & D*, (Bandung: Alfabeta, 2012), 336.

with competent sources and several other sources, such as papers, articles, documents, news, reports and online media which are related to *Wariga*.

3. Method of Data Collecting

a) Interview Method

Interview Method is the method of collecting data by conducting interviews to obtain information and opinions orally by asking directly with respondents.²¹ Interviews were conducted via telephone to obtain data on the *Wariga* systematics in the Balinese calendar and its used for determining season.

b) Documentation Method

The documentation method is collecting data or facts that are arranged logically from a number of materials. The author collects books, papers, documents and all things related to *Wariga*. The main documents of this research are a book entitled "*Dasar Wariga*" by Ida Bagus Putra Manik Aryana, S.S. and Balinese calendar.

4. Technique Of Data Analysis

After the data is collected, it is processed and analyzed. The method that author use to analyze these

69. ²¹ Bagong Suyanto, *Metode Penelitian Sosial*, (Jakarta : Kencana, 2005),

data is qualitative. Due the fact that the data to be analyzed is in the form of data obtained through a qualitative approach, then data analysis in this study used descriptive techniques, structural analysis, and text interpretation. The descriptive technique is a way to examine an object, whether in the form of manuscripts, documents, cultural values, ethics, works of art, or other events or objects of study.²² This analysis is needed to determine how systematic the calculations of the Bali *Wariga* are on the occasion of discussed through an astronomical approach.

G. Systematics of Writing

Broadly speaking, the writing of this research refers to the second type of qualitative method writing from "Pedoman Penulisan Skripsi Program Sarjana Fakultas Syari'ah dan Hukum UIN Walisongo Semarang". Consist of five chapters which each chapter consists of sub-discussion sections, the contents are follows :

The first chapter are contains the background of the problem, the definition of terms, the formulation of the problem, the research objectives, the literature review, and the research methodology.

²² Sugiyono. *Metode Penelitian Kuantitatif, Kualitatif dan R & D*, (Bandung: Alfabeta, 2012), 243.

The second chapter are contains theoretical framework about various kinds of seasons, time reckoning and types of calendars in the world.

The third chapter is discussing about the general description of Balinese Calendar and *Wariga*, including the definition and history of *Wariga* and also the Scope of *Wariga* in Balinese life. Next describing the *Wariga* Calculation System in Determining the Season taken from several kinds of literature.

The fourth chapter is analysis. Will be explained on this part the author's thoughts on Seasonal Forecast in the Bali *Wariga* Calculation System using an astronomical approach and the accuracy of the beginning of the season on the Bali *Wariga* system.

The fifth chapter are contains conclusion presented according with the data, which have been analyzed in the previous chapter. Investigation and discussion of the result of the research aims to answer problems and results from research which has been conducted, then interpret the finding in the research to be knowledge.

CHAPTER II

THE SEASON AND TIME RECKONING

A. Understanding The Season

1. Definition of Season

A season is a division of the year¹ generally based on yearly periodic changes in weather. According to Soerjadi and Yunus, season is an interval of time with the most frequent or striking weather². Meanwhile, according to Bayong, the season is the period with the most striking climatic elements³. Season can also be interpreted as one of the main divisions of the year, usually based on broad climatic forms.

Discussing about season, it cannot be separated from the weather and climate. Weather means predicted atmospheric conditions in a short span of time and a narrow area, while climate is a predicted atmospheric condition with a relatively long period of time and a wide area coverage.⁴ Therefore, climate and weather are part of an effort to read or predict nature to determine a season in a certain area.

¹ Definition of “Season”, *Merriam-Webster.com*, (2021), as quoted in <https://www.merriam-webster.com> retrieved 20 March 2021.

² Soerjadi Wirjohamidjojo & Yunus S. Swarinoto, *Praktek Meteorologi Pertanian*, (Jakarta: BMKG, 2007) , 11.

³ Dedi Sucahyono S & Kukuh Ribudiyanto, *Cuaca Dan Iklim Ekstrim Di Indonesia*, (Jakarta: Puslitbang BMKG, 2013), 21.

⁴ Suryatna Rafi“i, *Meteorologi dan Klimatologi*, (Bandung: Angkasa, 1995). 1.

2. The Causes of Season on Earth

a) Axial Tilt

On Earth, seasons are the result of Earth's orbit around the Sun and Earth's axial tilt relative to the ecliptic plane which is tilted 23.5 degrees.⁵ The effect of axial tilt is observable as the change in day length and altitude of the Sun at solar noon (the Sun's culmination) during the year. Between this effect and the shorter daylight hours, the axial tilt of the Earth accounts for most of the seasonal variation in climate in both hemispheres. Throughout the year, different parts of Earth receive the Sun's most direct rays.

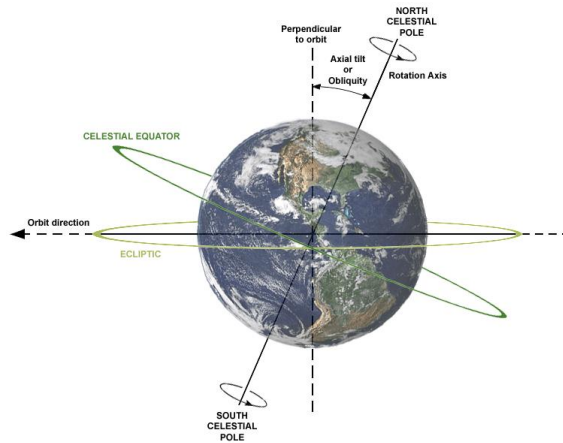


Figure 2.1 Earth's axial tilt

(<https://www.universetoday.com/22603/mars-compared-to-earth/>)

⁵ Vyacheslav Khavrus & Ihor Shelevytsky, "Geometry and The Physics of Seasons", *Physics Education*, vol. 47, no. 6 (2012); IOP Publishing Ltd, 680–692

b) Revolution of Earth

Theoretically the reflection of the Earth's circulation around the Sun or commonly known in astronomy as the Earth's revolution⁶. This revolution produces an annual change in the position of the Sun in the sky, namely the pattern of changes in the annual seasons⁷. This regular (periodic) annual phenomenon due to changes in the position of the Sun causes seasonal changes in the Northern Hemisphere and the Southern Hemisphere⁸.

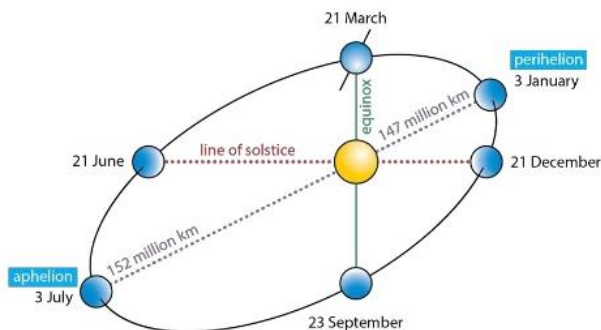


Figure 2.2 Reflection of the Earth's orbit around the Sun
(<https://www.researchgate.net/publication/220541439/>)

To make one complete revolution around the Sun, the Earth takes 365.24 days. This amount of time is the definition of one year. The gravitational pull of the Sun keeps Earth and the other planets in orbit around

⁶ Slamet Hambali, *Almanak Sepanjang Masa*, (Semarang: Program Pascasarjana IAIN Walisongo Semarang, 2011), 2.

⁷ Slamet Hambali, *Pengantar Ilmu Falak (Menyimak Proses Pembentukan Alam Semesta)*, (Banyuwangi: Bismillah Publisher, 2012), 206.

⁸ Muhyiddin Khazin, *Ilmu Falak: Dalam Teori dan Praktek*, (Yogyakarta: Buana Pustaka, 2004), 126.

the star. Like the other planets, Earth's orbital path is an ellipse so the planet is sometimes farther away from the Sun than at other times. The closest is a Perihelion, the Earth gets to the Sun each year is on about January 3rd and the furthest is at Aphelion on July 4th.

The winter solstice where the Earth has evolved around the Sun and the position of the Sun is farthest in the South (for the Northern hemisphere). This phenomenon occurred a few days before perihelion, precisely on December 21. Then in the Southern Hemisphere, the Sun will be directly overhead because the Sun's position is at 23.5° S.

The summer solstice is the position of the Sun at the most distant point in the North (for the Northern hemisphere). This phenomenon occurred a few days before aphelion, on June 21 to be precise⁹. Thus, in the northern hemisphere the Sun will be directly overhead because the Sun is at 23.5° N.

The position of the Sun is right on the equator or is at the equinox point. The intersection between the celestial equator and the ecliptic is called the equinox and it is at this time that day and night in all hemispheres have the same time interval.

The vernal equinox is where the celestial equator intersects with the ecliptic, commonly known as a marker of the entry of spring. The vernal equinox as the

⁹ Wiwit Suryanto & Alutsyah Lutfian, *Pengantar Meteorologi*, (Yogyakarta: Gadjah Mada University Press, 2019), 24.

starting point of this spring is periodically marked on March 21 each year.

While the autumnal equinox is the point of intersection between the ecliptic plane with the equator which is often known as the beginning of the entry of autumn. The autumnal equinox as the starting point of autumn is periodically marked on September 23 every year.

<i>i</i>	Perihelion		Vernal Equinox		Summer Solstice		Aphelion		Autumnal Equinox		Winter Solstice	
2014	04 Jan	18:58	20 Mar	23:57	21 Jun	17:51	04 Jul	07:13	23 Sep	09:29	22 Dec	06:03
2015	04 Jan	13:36	21 Mar	05:45	21 Jun	23:38	07 Jul	02:40	23 Sep	15:20	22 Dec	11:48
2016	03 Jan	05:49	20 Mar	11:30	21 Jun	05:34	04 Jul	23:23	22 Sep	21:21	21 Dec	17:44
2017	04 Jan	21:18	20 Mar	17:29	21 Jun	11:24	04 Jul	03:11	23 Sep	03:02	21 Dec	23:28
2018	03 Jan	12:05	20 Mar	23:15	21 Jun	17:07	06 Jul	23:47	23 Sep	08:54	22 Dec	05:23
2019	03 Jan	12:20	21 Mar	04:58	21 Jun	22:54	05 Jul	05:11	23 Sep	14:50	22 Dec	11:19
2020	05 Jan	14:48	20 Mar	10:50	21 Jun	04:44	04 Jul	18:35	22 Sep	20:31	21 Dec	17:02
2021	02 Jan	20:50	20 Mar	16:37	21 Jun	10:32	06 Jul	05:27	23 Sep	02:21	21 Dec	22:59
2022	04 Jan	13:54	20 Mar	22:33	21 Jun	16:14	04 Jul	14:11	23 Sep	08:04	22 Dec	04:48
2023	04 Jan	23:17	21 Mar	04:24	21 Jun	21:58	07 Jul	03:06	23 Sep	13:50	22 Dec	10:27
2024	03 Jan	07:38	20 Mar	10:06	21 Jun	03:51	05 Jul	12:06	22 Sep	19:44	21 Dec	16:20

Table 2.1 Perihelion, Aphelion, Equinox and Solstice for 2014 – 2024¹⁰
<https://www.weather.gov/media/ind/seasons.pdf>

c). Maritime and Hemispheric

Seasonal weather fluctuations (changes) also depend on factors such as proximity to oceans or other large bodies of water, currents in those oceans, El Niño and other oceanic cycles, and prevailing winds¹¹. In the temperate and polar regions, seasons are marked by changes in the amount of sunlight, which in turn often

¹⁰ Astronomical Applications Department U S, *Naval Observatory Earth's Seasons and Apsides*, as quoted in <https://www.weather.gov/media/ind/seasons.pdf> retrieved 25 March 2021.

¹¹ Stephen Fisher & Jerry Bobrow, *Cliffs Notes CSET: Multiple Subjects with CD-ROM*, (Boston: Houghton Mifflin Harcourt, 2012), 294.

causes cycles of dormancy in plants and hibernation in animals.

These effects vary with latitude and with proximity to bodies of water¹². For example, the South Pole is in the middle of the continent of Antarctica and therefore a considerable distance from the moderating influence of the southern oceans. The North Pole is in the Arctic Ocean, and thus its temperature extremes are buffered by the water.

The result is that the South Pole is consistently colder during the southern winter than the North Pole during the northern winter. The seasonal cycle in the polar and temperate zones of one hemisphere is opposite to that of the other. When it is summer in the Northern Hemisphere, it is winter in the Southern, and vice versa.

3. Season on Earth

Discussing the seasons in the study of Falak Science and Astronomy, it cannot be separated from the Gregorian calendar or Solar system. Most calendar-based methods use a four-season model to identify the warmest and coldest seasons, which are separated by two intermediate seasons. Due to the different geographical and astronomical locations in each region, not all of them experience these 4 seasons. The tropical areas that are close

¹² Rob DeMillo, *How Weather Works*, (California: Ziff-Davis Press, 2009), 135.

to the equator there are normally only two seasons, a wet season and a dry season.

Calendar Time		Hemisphere	
		Tropical	
April - September		Dry Season	
October - March		Rainy Season	
	Northern Hemisphere	Southern Hemisphere	
21 March - 21 June	Spring	Autumn	
21 June - 23 September	Summer	Winter	
23 September – 21 December	Autumn	Spring	
21 December – 21 March	Winter	Summer	

Table 2.2. Seasonal changes on earth in common.

Another type of calendar-based methods is a six-season method where the number of seasons between summer and winter can number from one to three. The dates are fixed at even intervals of months. For example in the Indian calendar of tropical and subtropical India, there are six seasons or Ritu¹³ that are calendar-based in the sense of having fixed dates.

¹³ Ritu (Sanskrit: ऋतु) or Paruvanelai (Tamil: பருவநிலை) defines "season" in different ancient Indian calendars used in countries, India, Bangladesh, Nepal and Sri Lanka, and there are six ritus (also transliterated ritu) or seasons. The word is derived from the Vedic Sanskrit word Ṛtú, a fixed or appointed time, especially the proper time for sacrifice (yajna) or ritual in Vedic religion; this in turn comes from the word Rta (ऋत), as used in Vedic Sanskrit

Indian Season	Start	End
<i>Vasanta</i> (Spring)	Mid-March	Mid-May
<i>Greeshma</i> (Summer)	Mid-May	Mid-July
<i>Varsha</i> (Monsoon)	Mid-July	Mid-September
<i>Sharad</i> (Autumn)	Mid-September	Mid-November
<i>Hemanta</i> (Early Winter)	Mid-November	Mid-January
<i>Shishira</i> (Prevernal or Late Winter)	Mid-January	Mid-March

Table 2.3. Indian Six-Season Method

4. Season in Indonesia

The geographical position of Indonesia is located in the tropics, in the continent of Asia and Australia, between the Pacific Ocean and the Indian Ocean, passed the equator, consists of the island and Nusantara stretching from west to east, and surrounded by the breadth of the ocean, causing parts of Indonesia has a high level of weather and climate diversity.¹⁴ Because of the position, Indonesia has two seasons, the dry and the wet seasons. These two seasons occur every year constantly alternating even though with a timeframe that continues to change every year, in the sense that in one year the rainy season is longer than summer or vice versa.

literally means the "order or course of things", See Singh Pramod, et. al, "Critical Review of Ritu (Season) With Special Reference to Current Research", *International Journal of Research*, vol. 3 no. 1 (2012), 33.

¹⁴ William C. Younce, *Indonesia: Issues, Historical Background and Bibliography*, (New York: Nova Publishers, 2001), 117.

In Indonesia, BMKG (*Badan Meteorologi, Klimatologi, dan Geofisika*) or Meteorology, Climatology and Geophysics Agency is one of the institutions that has the authority and competence to predict the weather, climate and seasons. In its study of the movement of the seasons or the shift of seasons, divides the season into two criteria¹⁵ :

a) Wet Season

The rainy season criteria are determined based on the amount of rainfall in one *dasarian* (10 days) equal to or more than 50 millimeters and followed by several subsequent bases. The start of the rainy season, can occur earlier (forward), the same or later (backward) than normal. When the data obtained has met the criteria, then when it can be said as the initial entry of the rainy season.

b) Dry Season

Criteria for the dry season is determined based on the amount of rainfall in a single *dasarian*¹⁶ (10 days) is less than 50 millimeters and was followed by several subsequent *Dasarian*. The start of the dry season, can occur earlier (forward), the same or later (backward)

¹⁵ BMKG Denpasar Wilayah III, *Daftar Istilah Musim*, as quoted in <http://balai3.denpasar.bmkg.go.id/daftar-istilah-musim/> retrieved 2 April 2021.

¹⁶ *Dasarian* is the number of data groupings in weather and climate observations in an area or area with a time span of 10 days, so that in one month there will be three observation data bases. See Pusat Survei Sumberdaya Alam Darat, *Prosiding Respons Cepat Terhadap Bencana Alam*, (Jakarta: Badan Koordinasi Survei dan Pemetaan Nasional, 2007), 4.

than normal. when the data obtained meet the existing criteria, then that time can be said to be the entry of the beginning of the summer or dry season. These two seasonal patterns are inseparable from the Indonesian climate. Climate is a state or physical condition of the atmosphere that is formed through the interaction of various elements or components called weather and climate elements that interact with each other. These elements include radiation or solar radiation duration, temperature, humidity, air pressure, wind, clouds, precipitation and evaporation.

In addition, BMKG also has several observations on phenomena that can affect climate and seasons in Indonesia, including¹⁷:

a). *El Nino and La Nina*

El Nino is a global phenomenon of an atmospheric oceanic interaction system characterized by temperature anomalies sea level in the Central Pacific Equatorial region where if the temperature anomaly sea level in the area is positive (warmer than average). On the other hand, if the sea surface temperature anomaly, is negative called *La Nina*. When there is an increase in sea surface temperature in the Central and Eastern Pacific Ocean around the equator known as El Nino, this is related to a decrease in rainfall in

¹⁷ BMKG National, *Buku Perkiraan Musim Kemarau 2021*, (Jakarta: Buletin BMKG, 2020): 1-2.

Indonesia. Likewise, when there is a decrease in sea surface temperature in the Middle and East Pacific Ocean around the equator or better known as La Nina, it is associated with increased rainfall in Indonesia¹⁸.

b). Indian Ocean Dipole (IOD)

Indian Ocean Dipole (IOD) is a phenomenon of the interaction of the ocean-atmosphere in the Indian Ocean which is monitored by calculating the difference in value between the anomalies of sea surface temperature waters of the east coast of Africa (West Tropical Indian Ocean, WTIO) with the waters west of Sumatra (Southeast Tropical Indian Ocean, SETIO). Differences in the sea surface temperature, anomaly value is referred to as Dipole Mode Index (DMI). Genesis positive IOD, generally led to a reduction of rainfall in Indonesia, especially in the west. While the negative IOD value, impact on increasing rainfall in western Indonesia.

c). Asia–Australia Monsoon Circulation

Wind circulation in Indonesia is determined by the pattern of differences in air pressure on the mainland of Australia and Asia. This air pressure

¹⁸ Muhammad Himmatur Riza and Nihayatul Minani, The Effect Of El Nino And La Nina On The Intensity Of Determining Qibla Direction, *Al-Hilal: Journal of Islamic Astronomy*, Vol. 3, No. 1, (2021), 56.

pattern follows the pattern of the sun's circulation in a year which causes the wind circulation in Indonesia to change its direction seasonally, or commonly called the monsoon wind. Monsoon winds are defined as wind circulations that change direction every (approximately) half a year. The westerly wind pattern occurs due to high pressure in Asia and is generally associated with the ongoing rainy season in most parts of Indonesia. The easterly wind pattern occurs due to high pressure in Australia and is usually associated with the ongoing dry season in most parts of Indonesia.

d). Inter Tropical Convergence Zone/ ITCZ

Inter Tropical Convergence Zone is a low pressure area that extends from west to east with a changing position following the apparent movement of the sun to the north and south of the equator, which is the confluence of air masses from the northern and southern hemispheres. In general, the areas of Indonesia that the ITCZ passes through have the potential for the growth of rain clouds.

e). Sea Surface Temperature In Indonesian Waters Territory.

Sea surface temperature conditions in Indonesian waters can be used as one indicator of many-at least the moisture content in the atmosphere, and is closely related to the process of

cloud formation over the territory of Indonesia. If the cold sea surface temperatures, the potential for moisture content in the atmosphere a bit, otherwise the heat of sea surface temperatures could potentially cause the amount of water vapor in the atmosphere.

B. The Time Reckoning

Time and the time reckoning are two terms that are closely related, but have slightly different meanings. Time is a sequence of events in succession and will not return and cannot be separated. The time reckoning is divided into two times, modern and traditional¹⁹.

1. Modern Time Reckoning

Modern Time Reckoning is the introduction of time that uses a homogeneous measure in the size of a large area. In accordance with the basis used to compile the calendar, it is known as the calendar based on the sun (solar) and the one based on the moon (lunar). The types of calendars in the introduction of modern time such as: Julian Calendar, Gregorian Calendar, *Hijriyah* Calendar, and so on.

2. Traditional Time Reckoning

¹⁹ Suwarman Partosuwiryo, *Pranata Mangsa Sebagai Alteratif Pedoman Untuk Penangkapan Ikan Di Samodera Hindia Selatan Daerah Istimewa Yogyakarta* as quoted in <https://nanopdf.com/download/pranata-mangsa-sebagai-alteratif-pedoman-untuk-pdf>, retrieved 9 April 2021)

The term ‘traditional’ defined as the delivery of elements of culture from one generation to the next²⁰, primarily delivered orally. Thus, the understanding of Traditional Time Reckoning can be interpreted as a calculation of time that being passed down from generation to generation. The types of calendars in the introduction of the traditional time reckoning such as: Chinese Calendar, Jewish Calendar, Egyptian Calendar, Mayan Calendar, Dayak Calendar, Maluku Calendar, *Perhalaaan* (Batak), *Wariga* (Bali), *Pranata Mangsa* (Java) and many more.

According to Anton Bakker, Humans and nature have a close relationship. Humans are objectively not only part of the world, but humans control themselves and their correlations with others that are lived in the world. So the world can not be used without humans, and vice versa, man and the world mutually imply, each containing²¹. This social order is institutionalized through a process of habituation (habitualization), each action that is often repeated and eventually becomes a pattern. This development gradually crystallized into a habit (folkways)²².

In a society, without the support of nature and its contents there will be no culture, and vice versa. So

²⁰ Geert Hofstede, *Cultures and Organizations: Software of the Mind*, (London: Harper Collins Business), 6.

²¹ Anton Bakker, *Kosmologi Metafisik* (Yogyakarta : Yayasan Fakultas Filsafat UGM , 1970), 2.

²² Maulana Hasanudin, “The Role of Judges in Dealing with Community Development”, *Walisongo Law Review (Walrev)*, vol 2 no. 2 (2020), 198.

that nature becomes a means of society to create culture, as a collection of ideas, which shows the process of continuous investigation for the basis of knowledge action. This nature is the result of human efforts to connect various meanings in experience, in a way to confirm valuable experiences, and by conducting investigations and testing to determine what is proven that will continue to be valuable²³.

Modern society makes time as a means of regulating, coordinating and organizing human activities. Hence time gets an amazing autonomous quality. Time becomes independent, the main variable, the main determining factor in life²⁴. But don't forget how the traditional people plotting the alignment of the stars and other heavenly bodies, they were able to organize their lives and determining time which has survived for now on. In Nusantara, the emergence of calendars in each region has its respective functions and meanings. It all depends on how the calendar user treats and interprets the calendar. In Batak, people interpret the calendar to determine good and bad days. In Java and Bali, the *Pranatamangsa* and *Sasih* calendar are interpreted as a marker of the season for farming.

3. World Calendar System

²³ Paschalis Maria Laksono, *Cerita Rakyat Dari Lampung 2*, (Jakarta: Prenada, 2007), 53.

²⁴ Piotr Sztompka, *The Sociology Of Social Change*, translated by Alimandan, *Sosiologi Perubahan Sosial*, (Jakarta: Grasindo, 1997), 2.

a). The Definition of Calendar

The term calendar comes from modern English "calendar" which comes from Old French and Latin "*calendarium*" means a notebook that gives money, according to Latin calendar, which means the beginning day of a month²⁵. In the Big Indonesian Dictionary, calendar means; Almanac²⁶; *Takwim*²⁷; *Tarikh*²⁸; list of days and months²⁹. Meanwhile, in terms of terminology, some experts provide quite diverse definitions :

1) Moh Ilyas

“The calendar is a time system that reflects the power and strength of a civilization³⁰. This is done by giving names to periods of time, day, week, month, and year. The name given to each day is known as a calendar. Periods in a calendar (such as years and months) synchronized with the cycles of the Sun or the Moon”.

2) Slamet Hambali

²⁵ Ruswa Darsono, *Penanggalan Islam (Tinjauan Sistem, Fiqih dan Hisab Penanggalan)*, (Yogyakarta: Labda Press, 2010), 27.

²⁶ Ahmad Fauzi, “Almanak Menara Kudus: Study of Hisāb Results in 1990 until 2019”, *Al-Ahkam*, vol 29, no. 1, (April 2019), 110.

²⁷ *Takwim* has two meanings: date calculation and calendar, see Depdikbud, *Kamus Besar Bahasa Indonesia*, (Jakarta: Balai Pustaka, 2018), 1599.

²⁸ Some meanings of *Tarikh*: 1. Year calculation 2. Year number (number) 3. Date (day, month, and year), see Depdikbud, *Kamus Besar*, 1634.

²⁹ Depdikbud, *Kamus Besar*, 664

³⁰ Mohammad Ilyas, *The Quest for a United Islamic Calendar*, (Malaysia: International Islamic Calendar Program, 2000), 15.

“Almanac is a calculation system that aims to organize time in a certain period. Moon is a unit that is part of the almanac. The day is the smallest almanac unit, then the time system is hours, minutes and seconds”³¹.

3) Ahmad Izzuddin

"Calendar is a system for identifying or historical event markers on human civilization"³²

From the definition above, it can be concluded that the calendar is a system of organizing time in the long term that play an important role in human civilization and have an effect on the social and of religious life, which can be used as a basis for determining the praying activity and other important work.

b). Calendar Function

The calendar in the world today has an important meaning for human life. At least some of the significance of the calendar for human life³³ can be divided into some context as follows :

1). Global world context

³¹ Slamet Hambali, *Almanak Sepanjang Masa*, (Semarang: Program Pascasarjana IAIN Walisongo Semarang, 2011), 3.

³² Ahmad Izzuddin, *Sistem Penanggalan*, (Semarang: Karya Abadi Jaya, 2015), ii.

³³ Arwin Juli Rakhmadi B., *Kalender: Sejarah dan Arti Pentingnya dalam Kehidupan*, (Semarang: CV. Bisnis Mulia Konsultama, 2015), 16.

In the context of the global world, the importance of a calendar is to control the time schedule. For if in the absence of the calendar can cause chaos moments of socio-religious and administrative world.

2). Universal context

Awareness of the importance of the calendar is something that can not be negotiable and even leads to a necessity.

3). Civilization context

The significance of a calendar within a civilization is as a symbol and confirm the existence of civilization. If in the context of ancient civilizations as a means of structuring the calendar function such time that naturally, then in the context of modern civilization is the unification efforts of time as a guide, a sign and a means for people in daily activities, and all the time.

c) **World Calendar History**

The Calendar in the past is very different today, in ancient times people make a calendar is by observing the natural phenomenon of the movement of celestial bodies repeatedly (regularity). They pay attention, study and then use it in life, but it is not known for sure who and when humans started observing and recording it.

Utilization of this calendar is used for farming, fishing and others³⁴.

The ability to observe astronomical phenomena and supported by high civilization, people in ancient times were able to arrange the regularity of the day which was grouped into months and the months were grouped into years³⁵. Then known the three most important construction units in a calendar, namely the day, month and year. So there are four things related to the calendar, namely observation, pattern formulation, calculation and implementation³⁶.

The oldest calendar regarding the lunar calendar is the Babylonian calendar, which is around 4000 BC. Then the Lunar-based Old Jewish calendar appeared in the 4th century and was changed to a Lunisolar base consisting of 12 months (29 days for odd months and 30 days for even months). the next civilization calendar Egyptians are based on the phenomenon of the Nile flood when rising star Sirius in the morning (the number of days in a year is 30 days every month plus 5 days as Rice 'so to 365 days). In the next development, namely the Ancient Greek calendar with the lunisolar system which is currently no longer used, this calendar runs for approximately 1000 years (from 776 BC to 337 AD).

³⁴ Hendro Setyanto, *Membaca Langit*, (Jakarta : Al-Guraba, 2008), 40.

³⁵ Darsono, *Penanggalan Islam*, 29

³⁶ Darsono, *Penanggalan Islam*, 31.

Beginning of the Greek calendar started that with the holding of the first Olympic sport in Greece³⁷.

The next is the ancient Roman calendar which began in 754 BC lunar-based system (one year for 304 days in 10 months, starting in March and ending in December). After the era of the kingdom of Numa Pompilius completed, followed by the King Roman calendar of Julius Caesar and his calendar is known as the Julian Calendar in 46 BC. King Julius Caesar changed the Roman calendar system which was originally based on the lunar system into a solar system with the help of Sosigenes from the Greeks, one year was 365 days 6 hours or 365.25 days and made every 4 years a leap year by adding 1 day in February.

This renewal of the Julian calendar is the Gregorian calendar which began with Pope Gregory XIII (1508-1585) at the suggestion of Consilia of Nicaea who found the difference in the Julian calendar calculation, namely the determination of the death of Isa al-Masih. Differences were found in the calculations performed by J. S. Clavius, proposed to Pope Gregory to add a correction to the Julian calendar was 10 days³⁸.

The next calendar is the Lunar-based Chinese Calendar which changed its system to Lunisolar in the

³⁷ Arwin Juli Rakhmadi Butar-butur, *Kalender, Sejarah dan Arti Pentingnya dalam Kehidupan*, (Semarang: CV. Bisnis Mulia Konsultama, 2014), 39.

³⁸ Fathurrohman, *Cara Mudah Belajar Ilmu Falak*, (Jombang: Muhipress, 2012), 61.

6th century BC. Hijri calendar is a calendar that emerged in the 7th century AD (with the cycle of 30 years). The Maya of Central America also has its own calendar, then the Sumerian calendar consisting of 12 months each year. The ancient Indian calendar with the number of days 360 days in a year and there is a period of time or for a man in her life is over 4320 years. However, the development of the Indian calendar is not known for certain. Based on the use of the number of days used, there is a possibility of India is a lunisolar calendar system.

d). Calendar Classification

The history of human civilization records that various calendar systems or calendars have been created by humans³⁹. There are quite a lot of calendar systems that develop in this world, both from ancient times to modern times, namely : The Primitive calendar, The Chinese calendar, The Egyptian calendar, The Indian calendar, The Babylonian calendar, The Jewish calendar, The Greek calendar and the Islamic/*Hijriyah* calendar⁴⁰.

Not only various systems, but each calendar also has a different method, resulting in different calculations which is calendar based on the Sun called the Solar Calendar and calendar based on the Moon

³⁹ Izzuddin, *Sistem Penanggalan*, ii

⁴⁰ Susiknan Azhari, *Ilmu Falak: Perjumpaan*, 94.

called the Lunar Calendar or those that use both systems known as Luni-Solar Calendar⁴¹.

1). Solar Calendar

The solar calendar system is a calendar that uses the reference of the Sun as a basis for calculations, the benchmark starts when the Sun is located at the equator in early spring in the northern hemisphere. One year is 365 days 5 hours 48 minutes 46 seconds (365.2422 days) or the length of time it takes the Earth to revolve around the Sun⁴².

This calendar system is based on the length of time it takes the Earth to make a revolution around the Sun. The period of revolution of the Earth to the Sun by long time taken in one year is divided into two, namely the sidereal year⁴³ and a tropical year⁴⁴. the number of days approaching the number of days in the tropics, this is how the calendar is in line with the changing seasons, so it can be used as a means to understand the general pattern of the changing seasons in a year.

⁴¹ Susiknan Azhari, *Ensiklopedi Hisab Rukyah*, (Yogyakarta: Pustaka Pelajar, 2008), 119.

⁴² Darsono, *Penanggalan Islam*, 32.

⁴³ Sidereal Year is the period of revolution of the Earth around the sun one full rotation elliptical takes during 365.2564 days or 365 days 6 hours 9 minutes 10 seconds.

⁴⁴ Tropical Year is the period required the apparent motion of the sun around the earth starting from point 1 to the equinox equinox 2 and then back to the equinox 1 is 365.2422 days.

2). Lunar Calendar

The Lunar Calendar is a time cycle system based on changes in the phases of the moon, marked by the appearance of a crescent moon after sunset, then in the following days the shape of the Moon will reach its peak shape on the 14th, then decrease and return like a crescent again⁴⁵.

This calendar system refers to changes in the phases of the Moon based on the synodic month. One lunar calendar year has 12 months, each month the average number of days is 29.5 days and the total period of the Moon's revolution to the Earth is 354 days 48 minutes 34 seconds. Thus, a lunar year will be 11 days shorter than a solar tropical year. This lunar calendar system has used the first visibility of the new moon, namely the Babylonian, Greek, Mayan, Inca, Chinese, Hindu, Jewish and Muslim or *Hijriyah* calendars, and astronomical scientists continue to develop astronomical criteria⁴⁶.

3). Luni-Solar Calendar

The Luni-Solar Calendar is a time cycle system based on the phenomenon of the moon and the sun. In practice, the solar system is used for

⁴⁵ Thomas Djamaluddin, *Menggagas Fiqih Astronomis (Telaah Hisab Rukyah dan Pencarian Solusi Perbedaan Hari Raya*, (Bandung : Kaki Langit, 2005), 74.

⁴⁶ Mohammad Ilyas, "Lunar Crescent Visibility Criterion and Islamic Calendar", *Quarterly Journal*, vol. 35, no. 4 (December 1994); Royal Astronomical Society, 438.

annual numbers while the lunar system is used for monthly activities⁴⁷. The month changes in this system is based on the synodic cycle of the Moon and several years must be inserted by an additional month (Intercalary Month) so that the calendar equals the length of the tropical year Sun.

The intercalary month consists of 13 months 7 times in 19 years, the 3rd, 6th, 8th, 11th, 14th, 17th, and 19th years. If accumulated in 19 years, in this Luni-Solar calendar there will be 235 months, 228 months plus 7 insert month⁴⁸. Some calendars that use the Lunar-Solar calendar system are the Chinese, Jewish Calendar (Jewish), Hindu Calendar (Saka) and Buddhist Calendar.

Next, the calendar system based on differences in the basic units of days, months or years, then it can be classified into two types, namely the calendar arithmetic and astronomical calendar.

1). Arithmetic Calendar

Arithmetic calendar is a calendar calculation used only by arithmetic⁴⁹. This calendar system can be calculated with a simple calculation so that the determination of the number of days in a month to be 29 or 30 respectively. In particular, this calendar

⁴⁷ Rakhmadi B., *Kalender*, 13.

⁴⁸ Mohammad Ilyas, *Astronomy of Islamic Calendar*, (Kuala Lumpur: A.S Noordeen, 1997), 27.

⁴⁹ Izzuddin, *Sistem Penanggalan*, 36.

does not need to make astronomical observations using the calendar. Theory-based modeling in the calculations are made based on observation data obtained, then the astronomers will be able to predict the phenomenon will occur so that it can be prepared the calendar arithmetic observations⁵⁰.

2). Astronomic Calendar

An astronomical calendar is a calendar based on continuous observation of the position of a celestial body and has astronomical calculations that are much more complicated than the arithmetic calendar⁵¹. One of the benchmark celestial bodies is the moon, because the average circulation of the moon does not match the shape of the new moon at the beginning of the month⁵². The indications stating that a calendar is an astronomical calendar, among others, this calendar refers to the circulation of a celestial body to the Earth and the system used using modern astronomical theory based on the astronomical reality that happened⁵³.

⁵⁰ Setyanto, *Membaca Langit*, 16.

⁵¹ Izzuddin, *Sistem Penanggalan*, 41.

⁵² Susiknan Azhari, *Pembaharuan Pemikiran Hisab Di Indonesia, Studi Atas Pemikiran Sa'adoeddin Djambek*, (Yogyakarta: Pustaka Pelajar, 2002), 24.

⁵³ Jayusman, "Aspek Ketauhidan Dalam Sistem Kalender Hijriah", *Al-Adyan: Jurnal Studi Lintas Agama*, vol 5 no.1, (1 June 2010); UIN Raden Intan, 85.

CHAPTER III

THE BALI WARIGA AND ITS SEASONAL SYSTEM

A. Balinese Calendar

Discussing about *Wariga* certainly cannot be separated from the Balinese calendar. The Balinese calendar to the Saka calendar system in India¹. This calendar has 12 months in a year, where each month is 30 tithi (days in the Hindu calendar, the time varies from 20-27 hours) which is divided into two halves of Shuklapaksa or penanggal and Khresnapaksa or panglong.

The invasion of Majapahit in Bali around the 14th century AD, making the Balinese calendar system almost the same as the Javanese calendar system. The calendar then be grown to the particularities of each region, after Bali independent of the Majapahit kingdom and has its own system. So that around nine kingdoms in Bali have their own calendar system². What is unique about the Balinese Calendar is the weekly system in it which consists of 10 kinds of weekly cycles, each of which has a function.

Balinese people believe that time is a mystery, so that almost all traces of Balinese life seem to be regulated by Ala Ayuning Dewasa. Ala Ayuning Dewasa is a time view of the good and bad of a day whose system is then called *Wariga*.

¹ Agus Mostafa, *Jangan Asal Ikut-ikutan Hisab & Rukyat*, (Surabaya: Padma Press, 2013), 53.

² Fajri Zulia Ramdhani, “Eksistensi Kalender Bali dalam Kultur Sosial Masyarakat Multireligius Bali”, *Religious: Jurnal Studi Agama-Agama dan Lintas Budaya*, vol. 4 no.2, (2020), 83.

The accuracy of choosing a day is a manifestation of how Balinese people value time. The context of socio-religious-agrarian civilization, Ala Ayuning Dewasa is written in dozens of Lontar (papyrus-shaped text).

Unlike other calendars, the Balinese Saka calendar has yet to be determined who created it. However, looking at its development and circulation, it was found that Mr. I Gusti Bagus Sugriwa and Mr. I Ketut Bambang Gede Rawi were the pioneers of the Balinese calendar which is inherited today³

B. Understanding The *Wariga*

1. The Definition of *Wariga*

Wariga word comes from the Sanskrit, the word *wara + i + ga*. *Wara* means chosen, best, superior; "I" is described as a preposition meaning "to or towards"; while the "Ga" means "road or go"⁴. In the Balinese dictionary, the word *Wara* which means day is known and *Wariga* which means the teaching of "*Diwasa/Dewasa*" which means good and bad days to start something⁵.

In the *Wariga Gemet* text it is explained about the root of the word *Wariga*, there is a quote as follows:

³ Look at the 2021 Balinese Calendar, on the back of the calendar. Balinese Saka Calendar based on Paruman Sulinggih's Decree dated 18 September 2001 and Conclusion of Scientific Seminar at Hindu University of Indonesia on 5 March 2004 By I Gede Marayana.

⁴ I B Namayuda, *Fungsi Wariga di Bali*, (Denpasar: Fakultas Agama dan Kebudayaan IHD, 1980), 20.

⁵ J Kersten S.V.D., *Bahasa Bali; Kamus Bahasa Lumrah*, (Flores: Nusa Indah, 1984), 638.

“Ika pawaking sang wiku, wruhing Wariga gemet Wa, nga, apadang; Ri, nga, tung-tung; Ga, nga, carira. ika carira tanpa carira ngaran, tanpa dwe buddhi, hala hayu, wang ring kasaman tasak ring padhartta, dhiksita, blahaning lango buddhi”.

The meaning :

“The presence of the *Wiku* (priests) who have known *Wariga Gemet* teachings. *Wa* means by light, *Ri* means the peak, *Ga* means the container. This is an unreal container, without will, good and bad, from fellow human beings he has been qualified in analysis, he has been purified, free

Balinese people believe that time is a thing of mystery, so that almost all traces of the Balinese people live as ruled by *Ala Ayuning Dewasa* (time view of the good and bad of the day)⁶. Based on the description above, The Bali *Wariga* is a calendar system that teaches knowledge or Balinese traditional date system, especially in determining good and bad days in order to start a job and also serves as a guide for mankind to achieve the best. The Bali *Wariga* discuss the mechanism of the calendar Caka

⁶ I Putu Cahya Prawira, et. al., “Pengembangan Aplikasi Kalender Saka Bali pada Sistem Operasi Machintos”, *Menara Penelitian Akademika Teknologi Informasi, Program Studi Teknologi Informasi, Fakultas Teknik Universitas Udayana* Vol. 3 No. 2, (Agustus 2015), 61.

calendar relates to the day-cycles that are the engine of Balinese divination⁷.

2. The History of *Wariga* in Bali

The development of *Wariga* in Bali certainly cannot be separated from its source, namely the *Vedas*. The *Vedas* in its understanding requires an auxiliary science called *Vedāṅga*⁸ which consists of *Sikṣa*, is knowledge of vedic phonetics; *Vyākaraṇa*, is knowledge of vedic grammar; *Chāṇḍa* is the knowledge of rhythm, song, and rhyme in the vedic scriptures; *Nirukta* is the study of origins and etymology in the Vedas; *Jyotiṣa* is knowledge of astronomy and astrology; and *Kalpa* is knowledge of how to perform ceremonies⁹.

In the *Wariga* script in Bali, especially in the papyrus-shaped text called *lontar* entitled "*Wariga Bhagawan Garga*", it can be seen from the description of the revelation of God regarding the *Jyotiṣa Veda* which in Bali is better known as *Wariga*¹⁰. *Jyotiṣa* estimated dated to 1400-1200 BC¹¹. This knowledge is very useful for

⁷ Ian Proudfoot, "In Search For Lost Time Javanese And Balinese Understanding Of The Indic Calendar", *Bijdragen tot de Taal-, Land- en Volkenkunde*, vol. 163, no. 1, 1 January 2018, (Leiden, Koninklijk Instituut voor Taal-, Land- en Volkenkunde), 89-90.

⁸ I Made Titib, *Veda Sabda Suci: Pedoman Praktis Kehidupan*, (Surabaya: Paramita, 1996), 124.

⁹ Hilman Hadikusuma, *Antropologi Agama: Pendekatan Budaya Terhadap Aliran Kepercayaan, Agama Hindu, Budha, Kong Hu Cu Di Indonesia*, (Bandung: Citra Aditya Bakti, 2009), 158.

¹⁰ I B Putra Manik Aryana, *Dasar Wariga : Kearifan Alam Dalam Sistem Tarikh Bali*, (Denpasar: Bali Aga, 2009), 3.

¹¹ Purana Vedas, *Vedic Astronomy*, as quoted in <https://www.puranavedas.com/vedic-astronomy/> retrieved 4 April 2021.

determining auspicious days in carrying out Vedic ceremonies. Around the fourth century AD, it was compiled systematically and scientifically about Indian astronomy, which was published in five books and was known as *Panca Siddanta*.

The date or year calculation system used in India before the spread of Hinduism to the Nusantara was *Cakawarsa* or *Caka Year*. The creation of this year is the most important moment of the reign of Maharaja Kanishka of the *Caka* dynasty over most of northern Iran and Afghanistan. The beginning of the *Caka* year began after 78 AD, preceded by an astronomical event where on Sunday, March 21, 79 the *tilem Caitra / Kasanga*, the king Kanishka announced a new date which was later called *Cakawarsa* or *Caka Year*¹².

Evidence of the spread of the *Caka* and *Jyotisa* dates in Bali can be seen in the inclusion of the *Caka* year numbers, the terms of day and month on most of the Nusantara's inscriptions. India's influence on Bali occurred during the reign of the ancient Balinese kings, especially during the reign of Singha Mandawa (882-942 AD). Furthermore, it was transformed more through Java, especially during the Mataram kingdom in East Java (around 1017 AD) from the Wangsa Isyana dynasty (Medang kingdom) which at that time was ruled by King Dharmawangsa Teguh. At that time the younger sister of the king named Mahendradatta or Gunapriya Dharmapatni

¹² Aryana, *Dasar Wariga*, 5.

was married to Udayana, the Balinese king of the Warmadewa dynasty¹³.

Evidence inscription before the 10th Century *wewaran* name is not yet available, but it has been mentioned regarding *Penanggal Panglong* and *Sasih* presented in Sanskrit and ancient Balinese language. When Gunapriyadharmapatni (Mahendradatta) and her husband, Darma Udayana Warmadewa, ruled in Bali from 989-1001 AD, the names of *wewaran* and *wuku* were mentioned in Old Javanese inscriptions. Since then *Wariga* is taught by Panditas, and so on as a guide or guide in all ceremonies and work that starts on auspicious days¹⁴. The occurrence of a fusion of cultures as described above includes the acculturation of the original Indonesian astronomy science with Hindu Astronomy (*Jyotisa*), this later in Bali known as *Wariga*. The use of *Wariga* as a time reckoning is not limited to certain areas such as Bali. but also other areas such as Lampung, Lombok, Kalimantan and others.¹⁵

3. Basic Knowledge of *Wariga*

Wariga science structure has units and formulas matter of time into the anatomy and axioms *Wariga*

¹³ Marwati Djoened Poesponegoro & Nugroho Notosusanto, *Sejarah Nasional Indonesia, I, II, III, IV, V*”, (Jakarta: Balai Pustaka, 1998), 434.

¹⁴ I Putu Cahya Prawira, et.al, “Pengembangan Aplikasi Kalender Saka Bali Pada Sistem Operasi Machintos”, *Journal Merpati*, Vol. 3, No. 2, August 2015, (Badung: Faculty of Engineering Udayana University), 60.

¹⁵ Based on interviews with Made Yuda Asmara, one of the *Wariga* experts from Karangasem, Bali. The interview was conducted via the WhatsApp text on May 30, 2021.

knowledge. This axiom is called *Alahing Śasih*. Guweng mention *Alahing Śasih* are as follows¹⁶ :

Wewāran alah dening Wuku. Wuku alah dening Penanggal/ Panglong, Penanggal/Panglong alah dening Śasih, Śasih alah dening Dauh, Dauh Alah dening Sang Hyang Trayo Dasa Saksi.

The meaning :

Wewaran is relegated by *Wuku*, *Wuku* is relegated by *Penanggal/Panglong*, *Penanggal/Panglong* is relegated by *Śasih*, *Śasih* is relegated by *Dauh*, and *Dauh* is relegated by *Sang Hyang Trayo Dasa Saksi*.

Here “*alah dening*” means overshadowed or relegated by (the higher/greater). For example, “*Penanggal/Panglong alah dening Sasih (penanggal/panglong* is relegated by *Sasih*”. When the day is to be used as the cremation function for the dead determined with reference to *penanggal/panglong* is considered *good/best after consulting the value (urip) of each penanggal/panglong*, but the *Sasih* is found bad for cremation, then the *penanggal/panglong* should be relegated by the *Sasih*. The proper/right *Sasih* should be selected. The formulation starts from the lower importance to higher one. In calculation, a priest will give importance to the solar-lunar system rather than *wuku* system. However, in practice local or village tradition sometimes become a serious consideration in granting a

¹⁶ I Ketut Guweng, *Sarining Wariga*, (Publisher not identified), 5.

good / proper day (*Subha Dewasa*) to a follower, especially related to cremation ceremony¹⁷.

a) *Wuku*

The calendar system used in the calculation *Wariga* also known on the basis *wuku*. One *wuku* cycle consisting of 30 *wuku* x 7 days = 210 days. 1 *wuku* year consists of 2 *wuku* cycles, so 30 *wuku* x 7 days x 2 cycle = 420 days.

The names of the *wuku* are as follows; *Sinta*, *Landep*, *Ukir*, *Kulantir*, *Taulu*, *Gumbreg*, *Wariga*, *Warigadean*, *Julungwangi*, *Sungsang*, *Dunggulan*, *Kuningan*, *Langkir*, *Medangsia*, *Pujut*, *Pahang*, *Krulut*, *Merakih*, *Tambir*, *Medangkungan*, *Matal*, *Uye*, *Menial*, *Prangbakat*, *Bala*, *Ugu*, *Wayang*, *Klawu*, *Dukut* And *Watugunung*¹⁸.

The following will present the numbering of *wuku* and *neptu* (*urip*). This *wuku* number has something to do with the calculation of *wewaran*, especially in the *Tri Wara* to *Sanga Wara*.

<i>Wuku</i>	<i>Neptu</i>	Position
<i>Sinta</i>	7	<i>Pascima</i> / West
<i>Landep</i>	1	<i>Wayabya</i> / Northwest
<i>Ukir</i>	4	<i>Uttara</i> / North
<i>Kulantir</i>	6	<i>Airsanya</i> / Northeast
<i>Tolu</i>	5	<i>Purwa</i> / East

¹⁷ I. B. P. Suamba and I. G. Mudana, "Time in rituals of Javanese-Saivism as preserved in Bali", *Journal of Physics: Conference Series*, vol. 953, 2018, (Philadelphia, Institute of Physics Publishing), 6.

¹⁸ I. B. Suparta Ardhana, *Pokok-Pokok Wariga*, (Surabaya: Paramita, 2006), 8.

<i>Gumbreg</i>	8	<i>Geneyan / Southeast</i>
<i>Wariga</i>	9	<i>Daksina / South</i>
<i>Warigadean</i>	3	<i>Nairiti / Southwest</i>
<i>Julungwangi</i>	7	<i>Pascima / West</i>
<i>Sungsang</i>	1	<i>Wayabya / Northwest</i>
<i>Dungulan</i>	4	<i>Uttara / North</i>
<i>Kuningan</i>	6	<i>Airsanya / Northeast</i>
<i>Langkir</i>	5	<i>Purwa / East</i>
<i>Medangsy</i>	8	<i>Geneyan / Southeast</i>
<i>Pujut</i>	9	<i>Daksina / South</i>
<i>Pahang</i>	3	<i>Nairiti / Southwest</i>
<i>Kerulut</i>	7	<i>Pascima / West</i>
<i>Merakih</i>	1	<i>Wayabya / Northwest</i>
<i>Tambir</i>	4	<i>Uttara / North</i>
<i>Medangkungan</i>	6	<i>Airsanya / Northeast</i>
<i>Matal</i>	5	<i>Purwa / East</i>
<i>Uye</i>	8	<i>Geneyan / Southeast</i>
<i>Menahil</i>	9	<i>Daksina / South</i>
<i>Perangbakat</i>	3	<i>Nairiti / Southwest</i>
<i>Bala</i>	7	<i>Pascima / West</i>
<i>Ugu</i>	1	<i>Wayabya / Northwest</i>
<i>Wayang</i>	4	<i>Uttara / North</i>
<i>Kelawu</i>	6	<i>Airsanya / Northeast</i>
<i>Dukut</i>	5	<i>Purwa / East</i>
<i>Watugunung</i>	8	<i>Geneyan / Southeast</i>

Table 3.1. The numbering of wuku and its neptu (urip).

b) *Wewaran*

Wewaran comes from the word "wara" which can be interpreted as a day, such as Monday, Tuesday etc. The rotation time of one cycle is not the same as the

way it is assembled¹⁹. This cycle is known for example in the Hindu calendar system by the term number, as follows²⁰;

1. *Eka Wara; Luang*
2. *Dwi Wara; Menga, Pepet.*
3. *Tri Wara; Pasah, Beteng, Kajeng.*
4. *Catur Wara ; Sri, Laba, Jaya, Menala.*
5. *Panca Wara; Umanis, Paing, Pon, Wage, Kliwon.*
6. *Sad Wara; Tungleh, Aryang, Urukung, Paniron, Was, Maulu.*
7. *Sapta Wara; Redite, Soma, Anggara, Buddha, Wrihaspati, Sukra, Saniscara.*
8. *Asta Wara; Sri, Indra, Guru, Yama, Ludra, Brahma, Kala, Uma.*
9. *Sanga Wara; Dangu, Jangur, Gigis, Nohan, Ogan, Erangan, Urungan, Tulus, Dadi.*
10. *Dasa Wara; Pandita, Pati, Suka, Duka, Sri, Manuh, Manusa, Raja, Dewa, Raksasa.*

In addition to the division of cycles which is the division of time by its names, further each statement is considered to have a value that is used to determine the measure of good and bad of a day. That value is called "*urip*" or *neptu* which is fixed. Therefore the value must be memorized.

In the calculation of *wewaran*, known certain formulas which becomes the basis for determining a matter of days in provisions *wuku* year. The relationship between *wewaran* and *wuku* is a determining factor in

¹⁹ Aryana, *Dasar Wariga*, 36.

²⁰ W. Simpen AB, *Pelajaran Dewasa (Wariga)*, (Denpasar: Muria, 1987), 8.

the number of days to be searched. For example, to look for the provisions of the *Tri Wara*, must be known *Neptu Wuku* and *Neptu Sapta Wara*, as well as the formula for determining them. This proves that both in *Wariga* have a unique composition obtained from mathematical calculations²¹.

The following will present the *neptu wewaran* which is the basis for calculating the formula. In this case, *Sapta Wara* will be very necessary in the search for other *wewaran* calculation results, as *Sapta Wara* is the common use today's society²².

<i>Wewaran</i>	<i>Wara</i>	<i>Direction</i>	<i>Neptu</i>
<i>Eka Wara</i>	<i>Luang</i>	<i>Wayabya / Northwest</i>	1
<i>Dwi Wara</i>	<i>Mange</i>	<i>Purwa / East</i>	5
	<i>Pepet</i>	<i>Pascima / West</i>	7
<i>Tri Wara</i>	<i>Dora</i>	<i>Daksina / South</i>	9
	<i>Wahya</i>	<i>Uttara / North</i>	4
	<i>Byantara</i>	<i>Pascima / West</i>	7
<i>Catur Wara</i>	<i>Sri</i>	<i>Uttara / North</i>	4
	<i>Laba</i>	<i>Purwa / East</i>	5
	<i>Jaya</i>	<i>Daksina / South</i>	9
	<i>Mandala</i>	<i>Pascima / West</i>	7
<i>Panca Wara</i>	<i>Umanis</i>	<i>Purwa / East</i>	5
	<i>Pahing</i>	<i>Daksina / South</i>	9
	<i>Pon</i>	<i>Pascima / West</i>	7
	<i>Wage</i>	<i>Uttara / North</i>	4

²¹ Aryana, *Dasar Wariga*, 36.

²² Aryana, *Dasar Wariga*, 36-39.

	<i>Kliwon</i>	<i>Madya / Center</i>	8
<i>Sad Wara</i>	<i>Tungleh</i>	<i>Pascima / West</i>	7
	<i>Aryang</i>	<i>Airsanya / Northeast</i>	6
	<i>Wurukung</i>	<i>Purwa / East</i>	5
	<i>Paniron</i>	<i>Geneyan / Southeast</i>	8
	<i>Was</i>	<i>Daksina / South</i>	9
	<i>Maulu</i>	<i>Nairiti / Southwest</i>	3
<i>Sapta Wara</i>	<i>Redite</i>	<i>Purwa / East</i>	5
	<i>Coma</i>	<i>Uttara / North</i>	4
	<i>Anggara</i>	<i>Nairiti / Southwest</i>	3
	<i>Buddha</i>	<i>Pascima / West</i>	7
	<i>Wraspati</i>	<i>Geneyan / Southeast</i>	8
	<i>Sukra</i>	<i>Airsanya / Northeast</i>	6
	<i>Saniscara</i>	<i>Daksina / South</i>	9
<i>Asta Wara</i>	<i>Sri</i>	<i>Airsanya / Northeast</i>	6
	<i>Indra</i>	<i>Purwa / East</i>	5
	<i>Guru</i>	<i>Geneyan / Southeast</i>	8
	<i>Yama</i>	<i>Daksina / South</i>	9
	<i>Ludra</i>	<i>Nairiti / Southwest</i>	3
	<i>Brahma</i>	<i>Pascima / West</i>	7
	<i>Kala</i>	<i>Wayabya / Northwest</i>	1
	<i>Uma</i>	<i>Uttara / North</i>	4
<i>Sanga Wara</i>	<i>Dangu</i>	<i>Daksina / South</i>	9
	<i>Jangur</i>	<i>Geneyan / Southeast</i>	8
	<i>Gigis</i>	<i>Airsanya / Northeast</i>	6
	<i>Nohan</i>	<i>Pascima / West</i>	7
	<i>Ogan</i>	<i>Uttara / North</i>	4
	<i>Erangan</i>	<i>Purwa / East</i>	5
	<i>Urungan</i>	<i>Pascima / West</i>	7
	<i>Tulus</i>	<i>Nairiti / Southwest</i>	3

	<i>Dadi</i>	<i>Uttara / North</i>	4
<i>Dasa Wara</i>	<i>Pandita</i>	<i>Wayabya / Northwest</i>	5
	<i>Pati</i>	<i>Madya / Center</i>	7
	<i>Suka</i>	<i>Nairiti / Southwest</i>	10
	<i>Duka</i>	<i>Nairiti / Southwest</i>	4
	<i>Sri</i>	<i>Uttara / North</i>	6
	<i>Manu</i>	<i>Purwa / East</i>	2
	<i>Manusa</i>	<i>Airsanya / Northeast</i>	3
	<i>Raja</i>	<i>Pascima / West</i>	8
	<i>Dewa</i>	<i>Geneyan / Southeast</i>	9
	<i>Raksasa</i>	<i>Daksina / South</i>	1

Table 3.2. The numbering of *wewaran* and its *neptu* (urip).

c). *Penanggal Panglong*

In addition to the calculation of *wuku* and *wewaran* there are also *Penanggal* and *Panglong* which is a system of adjusting the arrival of *Tilem* and *Purnama*²³ according to the position of the moon with respect to the sun and the earth. This is causes the age of the moon not to be 30 days, but 29 days. The reduction may occur on days from *Tilem* to *Purnama* called *Penanggal* or on days from *Purnama* to *Tilem* called *Panglong*. Calculation of the *Penanggal* starts 1 day after (D+1) *Tilem* day (dead moon) and *Panglong* starts 1 day after (D+1) *Purnama* day (full moon). Usually at

²³ Ariana, et.al, *Ala Ayuning Dewasa, Ketut Bangbang Gde Rawi* (Sebuah *Canangari*), (Denpasar: Penerbit ESBE Buku, 2016), 23

that time there is a *Purnama* celebration²⁴. This shows that there are two basic differences in the determination of *Purnama* and *Tilem*.

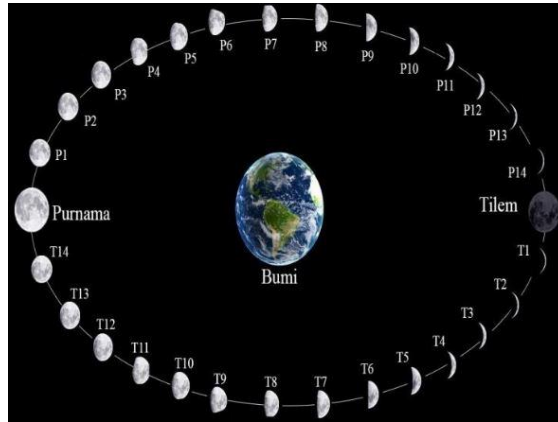


Figure 3.1. Illustration of Full Moon Phases, Tilem, Penanggal and Panglong
(Source: Wasudewa Bhattacharya, *Purnama-Tilem*)

d). *Sasih*

Sasih is literally the same as the moon. Equally it seems the international calendar, *Sasih* also be as many as 12 *Sasih* for a year, the calculation using the "Calculation of Constellations" in accordance with the solar year (12 constellations = 365/366 days) starting from 21 March. As for the *Sasih* division is;

1. *Kedasa* = *Mesa* = March – April.
2. *Jiyestha* = *Wresaba* = April – May

²⁴ Based on interviews with Luh Made Ari Chandra Yuni, one of the *Wariga* experts from Klungkung, Bali. The interview was conducted via the WhatsApp text on March 11, 2021.

3. *Sadha* = *Mintuna* = May – June
4. *Kasa* = *Rekata* = June– July
5. *Karo* = *Singa* = July – August
6. *Katiga* = *Kania* = August – September
7. *Kapat* = *Tula* = September – October
8. *Kalima* = *Mercika* = October – November
9. *Kanem* = *Danuh* = November – Desember
10. *Kapitu* = *Mekara* = Desember – January
11. *Kawulu* = *Kumba* = January – February
12. *Kasanga* = *Mina* = February – March.

e). ***Dauh***

Dauh is a term used in *Wariga* to determine the division of time in a day. What is meant by *Dauh* is the time or hour according to the rotation of the earth on its axis, which is repeated every 24 hours starting from the rising of the sun at 05.30. The significance of the *dewasa dauh* is needed if the ceremonies carried out are difficult to get a good day (*dewasa ayu*). A matter of hours in a day divided into 21 hours up to a day in a matter of 24 hours in length. 1 hour consists of 60 minutes and 1 minute consists of 60 seconds. *Wariga* in reviewing *Dauh* has several calculation methods, namely :

1. ***Panca Dauh***

Panca Dauh is the division of the length of the day in a day into 10 parts, where 5 *dauh* is used to calculate the length of the day/*rahina* (after

sunrise to sunset) and the other 5 *dauh* to calculate the length of the night/*wengi* (from sunset to before sunrise). *Dauh* used to look for the good times and a ceremonial procession is done at a certain time limit.

<i>Dauh</i>	<i>Rahina / Day</i>	<i>Wengi / Night</i>
1	06.00 – 08.23	03.36 – 05.59
2	08.24 – 10.47	01.12 – 03.35
3	10.48 – 13.11	22.48 – 01.11
4	13.12 – 15.53	20.24 – 22.47
5	15.36 – 17.59	18.00 – 20.23

Table 3.3. The Panca Dauh and hour in WITA.

2. Asta Dauh

The *Asta dauh* system has the same concept as the *Panca dauh*, the only difference is that the time is divided into 16, with the details of 8 *dauh* to calculate the length of time from sunrise to sunset and 8 more *dauh* to calculate the length of the night from sunset to sunrise.

<i>Dauh</i>	<i>Rahina / Day</i>	<i>Wengi / Night</i>
1	06.00 – 07.29	04.30 – 05.59
2	07.30 – 08.59	03.00 – 04.29
3	09.00 – 10.29	01.30 – 02.59
4	10.30 – 11.59	00.00 – 01.29
5	12.00 – 13.29	22.30 – 23.59
6	13.30 – 14.59	21.00 – 22.29
7	15.00 – 16.29	19.30 – 20.59
8	16.30 – 17.59	18.00 – 19.29

Table 3.4. The Asta Dauh and hour in WITA.

f). Wetu

What is meant by *wetu* is the nature or will of *Hyang Widhi* as the Almighty who regulates and determines everything. In this sense it is interpreted that the *ala ayuning dewasa* style can be excluded in very urgent circumstances, but using certain ceremonies and ceremonies. For example, if unavoidable carry out the mass burial ceremony as victims of war, riots, etc. then *padewasaan* can be excluded with the task of fully comprehending ceremony *piduka*, *macaru* mature style, *mapiuning* at Pura Dalem and others.

4. The Bali *Wariga* Seasonal System

1. Season / *Masa* Division

The season or '*Masa*' in Balinese terms is known as the *KertaMasa* or the *Sasih* calendar, in fact it is a collection of information about the time and characteristics of seasonal changes, especially in the archipelago which is influenced by the circulation of the sun. If viewed based on its function, there is no doubt that the seasonal system used as a season marker is a traditional climatological science.

Some of the characteristics of natural phenomena used include the movement of celestial bodies, the migration cycle of certain animals, rainfall, temperature changes, symptoms in plants, and other natural phenomena. These marked natural phenomena are then passed on to the next generation. In Balinese *Wariga*,

the ordinal names of months refer indiscriminately to lunar months in the Śaka year, while the months in the *Wariga* and Gregorian commonly using solar year system perspective as follows:

<i>Sasih Wariga</i>	Gregorian Month	Season
<i>Srawana</i> (1)	June	Dry
<i>Bhadrapada</i> (2)	July	Dry
<i>Aswina</i> (3)	August	Dry
<i>Kartika</i> (4)	September	Transition dry to rainy
<i>Magasirsa</i> (5)	October	Rainy
<i>Pusya</i> (6)	November	Rainy
<i>Mukha</i> (7)	December	Heavy rain
<i>Phalguna</i> (8)	January	Rainy
<i>Caitra</i> (9)	February	Rainy, strong wind
<i>Waisyaka</i> (10)	March	Transition rainy to dry
<i>Jyestha</i> (11)	April	Dry
<i>Asadha</i> (12)	May	Dry

Table 3.5. The month in *Wariga* and Gregorian Calendar

According to its development, in terms of the history and development of Indonesian ethnicity where people's knowledge is dominated to meet basic needs, the Balinese people make a kind of system used in determining the seasons known as *Sasih* calendar. The determination of this period can be seen in the current Balinese calendar. In general the season in *Wariga* system based on *Sasih* divided into two *Masa* namely :

1. **Lahru**

Lahru is the summer or dry season, which lasts between *Sasih* Waisaka, *Sasih* Kedasa to *Sasih* Katiga (around April to September).

2. **Rengreng**

Rengreng is the rainy or wet season, which lasts from *Sasih* Kapat to *Sasih* Sanga (around October to March).

From the division of the two major seasons, then it is further elaborated into 12 periods where each of these periods or seasons has its own characteristics and signs, which are as follows :

a) ***Kasa / Srawana / Rekata (22 June-1 August)***

Typically the first time this happened in June, which usually coincide with the beginning of the year based *Sasih* system. In this season the wind blows from the west. This period is marked by falling leaves and followed by plants starting to flower, especially durian, mangosteen, jackfruit. Insect eggs began to hatch and fish began to be rare. Farmer's activity this season are burn crop waste and planting crops.

b) ***Karo / Singa / Bhadrpada (2 August-24 August)***

Usually this period occurs in August. In this season the wind blows from the east with natural signs bright and airy weather. Trees are starting to bear fruit,

especially bananas, oranges and sapodilla. Reptiles at this time began to hatch, such as snakes. Farmers looking for water to irrigate crops.

c) *Katiga / Kania / Aswina* (25 August-17 September)

In this season the wind blows from the northeast with natural signs hot and dry. The tree has leaves, tuber plants are starting to bear fruit such as turmeric and ginger. Farmers' activities are watering plants and harvesting secondary crops.

d) *Kapat / Tula / Kartika* (18 September-12 October)

In this season the wind blows from the northwest, the weather is unpredictable. Annual plants begin to flower, especially tamarind trees. Birds started making nests to lay their eggs especially sparrows, farm animals began to proliferate, the fish in the river began much in the encounter. Farmers started plowing the fields.

e) *Kalima/ Mercika / Magasirsa* (13 October-8 November)

In this season the wind blows from the north with natural signs rain heavily and strong winds. Tamarind trees are starting to bloom, tuber plants are starting to leave leaves. the release of reptiles from their nests, more and more insects, especially flies. farmers began to regulate the distribution of water.

f) *Kanem / Danuh / Pusya* (9 November-21 Desember)

In this season the wind blows from the west, with natural signs of rain, strong winds, lightning and landslides. seasonal trees start to ripen especially mango, durian and rambutan. In waterways many

cockroaches and water fleas are found. the farmers began to spread the seeds.

g) *Kapitu / Mekara / Mukha* (22 Desember-2 February)

In this season the wind blows from the west, with natural signs of rain and floods. Seasonal plants still bear fruit, especially durian, salak, soursop and longan. farmers Farmer activities improve rice field bunds.

h) *Kaulu / Kumba / Phalguna* (3 February–28 February)

In this season the wind blows from the west, it started to rain and thunder. Sapodilla trees and rice began to flower. Breeding season for animals, especially cats and the emergence of fireflies in the fields. Farmers start clearing fields and harvesting secondary crops such as corn.

i) *Kasanga / Mina / Caitra* (1 March–25 March)

In this season the wind blows from the south, it started to drizzle and airy. Rice plants began to grow and seasonal crops began to bear fruit, especially kuini, kepundung and avocado. The sound of crickets began to be heard frequently.

j) *Kadasa / Mesa / Waisyaka* (26 March–18 April)

In this season the wind blows from the southeast, the weather is unpredictable. Rice plants are getting old, lime plants and duku are starting to bear fruit. farm animals began to get pregnant and birds began to make nests and incubate eggs. harvesting secondary crops and protecting rice from bird attacks.

k) *Jyesta / Wresba / Jyestha* (19 April–11 May)

In this season the wind blows from the east with natural signs hot and dry. The tubers are ready to be harvested and the rice is starting to turn yellow. Farmers harvest rice and tubers.

l) *Asada / Mintuna / Asadha* (12 May-21 June)

In this season the wind blows from the east with natural signs hot and dry, there is no rain. The leaves begin to wither, the season of fish in the sea. Farmers dry grain, burn straw and clear land for replanting.

2. The Method of Determining Season in Bali *Wariga*

1. *Surya Pralingga* (Sun)

Sasih's estimate based on the appearance of the sun in *Wariga* is known as *Surya Pralingga*. Its significance is used by fishermen and farmers in determining the season for fishing or farming. The basis of the calculation is to determine whether the sun's inclination point is inclined to the North (*Uttarayana*), South (*Daksinayana*), or is in the Middle (*Wiswayana*). The basis of this theory is adjusted to the position of the sun seen around the equator.

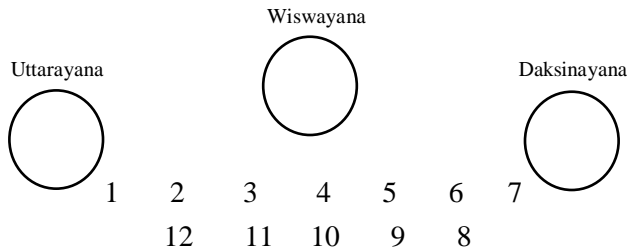


Figure 3.2. Interpretation of the seasons based on Uttarayana and Dakshinayana

In the figure above, illustrates how the position of the sun and its implications for determining the seasons based on the information of the *Wariga* system. The numbers 11, 12, 1, 2, and 3 the position of the sun at that time indicate summer or dry season. Then the numbers 5, 6, 7, 8, and 9 the position of the sun at that time indicate the rainy season. The last is numbers 4 and 10, at this time the position of the sun indicates the transition season.

2. *Naksatra Pralingga* (Star or Constellation)

Sasih's estimate based on the appearance of the star in *Wariga* is known as *Naksatra Pralingga*. The earliest use of constellations may have come from a religion or belief. Ancient humans thought that Gods lived in the sky and created the constellations, many cultures also believed that

the position of the stars was their God's way of telling stories²⁵.

Constellations are studied to meet the perceived needs of human. For example, to ensure when it is a good time to plant rice or determine the season, the ancient farmers used the constellation star as a marker²⁶. Traditional Balinese knowledge about astronomy is by paying high attention to celestial objects, especially constellations. They named several constellations as a guide according to *Agastya Parwa* text, including²⁷ :

Aswini (α *Arietis*), *Bharani* (41 *arietis*), *Kartika* (*Pleiades*), *Rohini* (α *tauri*), *Margasirah* (λ *Orionis*), *Adra* (α *Orionis*), *Punawarsu* (β *Geminorum*), *Pusya* (δ *Cancri*), *Aslesya* (α *Cancri*), *Magha* (α *Leonis*), *Purwapalghuni* (δ *Leonis*), *Uttrarapalghuni* (β *Leonis*), *Hasta* (*Corvus*), *Citra* (α *Virginis*), *Swati* (α *Bootis*), *Wisakha* (α *Libra*), *Anuradha* (δ *Scorpionis*), *Jyestha* (α *Scorpionis*), *Mula* (λ *Scorpionis*), *Purwasadha* (δ *Sagittarii*), *Uttarasadha* (σ *Sagittarii*), *Srawana* (α *Aquilae*), *Dhanistha* (α *Delphini*), *Satabisaj* (λ *Aquarii*), *Purwabhadrawada* (α *Pegasi*), *Rewati* (δ *Piscium*), and *Uttarabhadrawada* (γ *Pegasi*).

The significance of the constellations and stars used in the *Wariga* teachings have their respective purposes such

²⁵ A. Gunawan Admiranto, *Menjelajahi Bintang, Galaksi, dan Alam Semesta*, (Yogyakarta : Kanisius Yogyakarta, 2009), 10.

²⁶ Aditya Putra Ferza, "Simulasi Pengamatan Dan Pengenalan Rasi Bintang Dan Karakteristiknya Dengan Menggunakan Teknologi Google Cardboard", *Skripsi*, Fakultas Teknologi Informasi Institut Teknologi Sepuluh Nopember, (Surabaya, 2016), 1.

²⁷ Aryana, *Dasar Wariga*, 19.

as determining the seasons, marking time in agriculture, even divination or *Tatenger Palalintangan*.

To determine the start of the season, the ancient people of Bali observe the constellation *Waluku* which in astronomy is known as the constellation Orion. This constellation generally consists of 4 main stars that forming the body frame of the Hunter, namely Betelgeuse, Bellatrix, Saiph and Rigel. In the center of this constellation framework, there are 3 stars that form a straight line, and this is known as the Belt of Orion. Orion's belt consists of 3 main stars, namely Alnitak, Alnilam and Mintaka. The data of the appearance of the constellation orion according to the data of the wariga season that is :

<i>Masa (Season)</i>	<i>Genah (Place)</i>	<i>Dauh (Hour) in WITA</i>
I (June 22)	<i>Wetan/East</i>	1 (03.36-05.59)
II (August 2)	<i>Wetan/East</i>	1 (03.36-05.59)
III (August 25)	<i>Wetan/East</i>	1 (03.36-05.59)
IV (September 18)	<i>Amner/Above</i>	1 (03.36-05.59)
V (October 13)	<i>Kulon/West</i>	1 (03.36-05.59)
VI (November 9)	<i>Wetan/East</i>	4 (20.24-22.47)
VII (December 22)	<i>Wetan/East</i>	4 (20.24-22.47)
VIII (February)	<i>Amner/Above</i>	4 (20.24-22.47)
IX (March 1)	<i>Kulon/West</i>	4 (20.24-22.47)
X (March 26)	<i>Kulon/West</i>	4 (20.24-22.47)
XI (April 19)	<i>Kulon/West</i>	4 (20.24-22.47)
XII (May 12)	<i>Ngerem/Set</i>	4 (20.24-22.47)

Table 3.6. Orion Appearance Data of Bali Wariga Seasonal System.

CHAPTER IV

AN ANALYSIS OF SEASONAL SYSTEM OF BALI WARIGA

A. Analysis of Seasonal Determination System of Bali *Wariga* in Astronomic Perspective

Wariga and Balinese Saka Calendar are closely related. *Wariga* is the system used in calculating the Balinese calendar. The calculation of *Wariga* basically discusses about *Ala-Ayuning Dewasa* (*ala* means bad, *ayu* means good) or good and bad times in determining various community activities. For example agricultural or plantation activities, fisheries or animal husbandry, sailing, construction, business, weddings, ceremonies and others. *Wariga* is also used as a natural prediction, in this case predicting the season which is then useful in farming or sailing activities. Therefore, in finding the *Masa* or season of this year or after, it can easily be seen in the Balinese Saka calendar. The determination of the seasons or according to *Wariga*, refers to the three celestial bodies, namely the Sun, Moon, and Stars.

1. Sun

As previously explained, the basis of the calculation is to determine whether the sun's inclination point is inclined to the North (*Uttarayana*), South (*Daksinayana*), or is in the Equator (*Wiswayana*). This theory called *Kala* or the theory of time in Hinduism. The basis of this theory is adjusted to the position of the sun seen around the

equator. When the Sun travels from Capricorn to Gemini, then it is called *Uttarayana*, this is six months' time. While when the Sun travels from Cancer to Leo, Virgo, Libra, Scorpio, and Sagittarius then it is called *Dakshinayana*, which is also six months time.

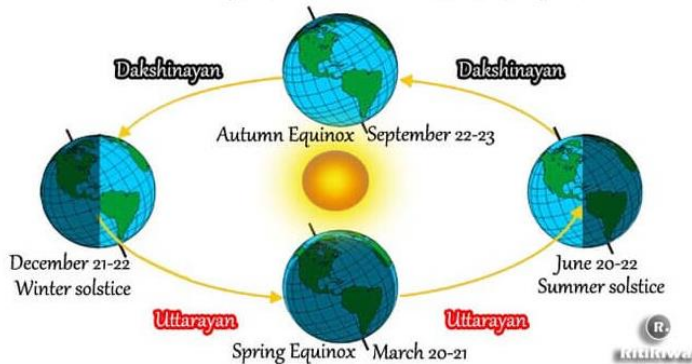


Figure 4.1. Annual Motion of Earth Around The Sun

The Earth is divided into a northern and southern hemisphere by an imaginary ring called the equator. Whichever hemisphere is more directly facing the Sun during the course of the Earth's orbit will receive more of the Sun's energy for more of the day. Clearly, the annual motion of the Earth around the Sun is the cause of Earth's seasons.

As the Sun crosses the Celestial Equator on about March 21, marking the beginning of the Spring in the Northern Hemisphere (and the Fall in the Southern Hemisphere), the day and night become equal in duration (12 hours each) all over the world. For the next three

months, the Sun moves northward and reaches a north-most point in about June 21.

After June 21, the Sun appears to start its journey southward crossing the Equator around September 23 (Autumnal Equinox). The Autumnal Equinox marks the beginning of the Fall Season in the Northern Hemisphere (and Spring in the Southern Hemisphere), and again on this day, the length of day and night become twelve hours each all over the world.

The territory of Indonesia is in a strategic position, located in the tropics, between the continents of Asia and Australia, between the Pacific Ocean and the Indian Ocean, and traversed by the equator, consists of islands and archipelagos stretching from West to East, there are many straits and bays, making the Indonesian territory vulnerable to climate change.

On March 21 the sun shines right at the equator and precisely also rises at the eastern point and sets at West point, the day arc and the night arc are the same length, therefore day and night are the same length, which is 12 hours. After March 21, the sun shines in the northern half of the globe, increasingly farther away or ranges from the equator until the 21st June, when the distance between the equator and the circle it travels equal to $23,5^{\circ}$ so for three months the Sun seems to make the circles in the sky, which are getting further and further away from the equator, on which date spring occurs at Northern Hemisphere and Southern Hemisphere autumn.

From June 21 to September 23, the sun gradually returning to the South approaching the Equator, the days are always getting a little longer, but still remained shorter than the night days. On that date there was summer in the Northern Hemisphere and winter in the Hemisphere South.

On September 23 to December 22 The sun begins to revolve farther from the equator, but is at half of the South circle. Its rising point is located on the South side the Eastern point and its setting point are south of the Western point. In the Northern hemisphere there is autumn and in the Southern hemisphere spring. On December 22 to March 21 the season occurs cold in the Northern hemisphere and summer in the Southern hemisphere.

On that date the Sun began to gradually return to the North to approach the equator, so that the daylight days became shorter. The regular change of seasons related to the regular change of the annual position of the Sun in the sky, as well as to the pattern of rainy seasons or wet seasons and summer or dry seasons in Nusantara.

2. Constellation

In many parts of Indonesia, people use their knowledge of the movements of the stars and patterns of stars, or “asterisms”, as markers for annual seasonal changes. In a wide variety of ecological regimes – irrigated, agriculture, and cultivation – the annual movements of stars have been used to bring together cultivation calendars and seasonal environments changes.

Historically, the Balinese probably developed one of the most elaborated correlations between the movement of stars and the beginning of season for agricultural cycle in the region was marked with observations of stars. The three stars are in a line that appears in the sky in the east, setting right in the west, and at midnight are overhead.

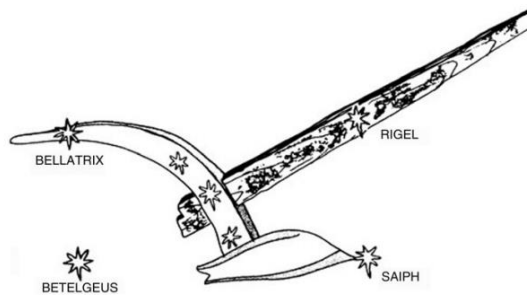


Figure 4.2. Waluku (The Plow)

(https://www.researchgate.net/publication/278681246_Cultural_Production_of_Skylore_in_Indonesia/figures?lo=1)¹

The plow, as an essential tool for agriculture, is an apt symbol for the cyclical changes of the cultivation year seen in the movements of stars. Indeed, at the start of the cultivation year, the celestial plow is seen in the east at dawn in its “upright position”, just like a farmer’s plow when it is in use. In contrast, by the end of the harvest, the plow, now seen low in the west and “upside down” in the evening sky, has moved to a position on the opposite

¹ Gene Ammarell & Anna Lowenhaupt Tsing, *Cultural Production of Skylore in Indonesia*, (New York: Springer Science & Business Media, 2015), 2210.

horizon and turned “upside down like a farmer’s plow when work is done”.

As for today's understanding of astronomy, if it is associated with the names of constellations and stars, the plow or *Waluku* identified with the “belt stars” (δ , ϵ and ζ Ori)² connecting its blade and handle, where all the stars is in the constellation Orion. This is in accordance with the appearance of Orion which has 3 inline stars used in determining the season of *Wariga*.

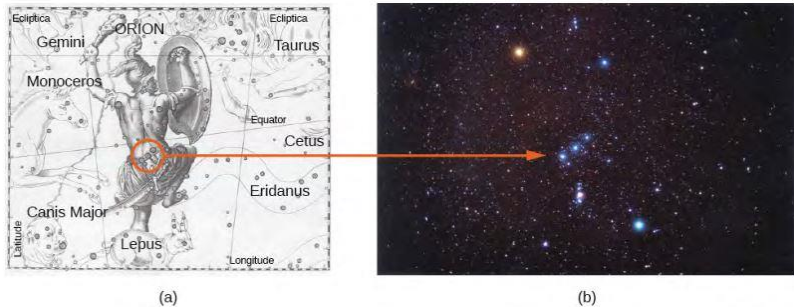


Figure 4.3. The Belt Star of Orion;
(credit a: modification of work by Johannes Hevelius; b: modification of work by Matthew Spinelli at Astronomy by Andrew Fraknoi)

The three blue stars that make up the belt of the hunter. The bright red star above the belt denotes his armpit and is called Betelgeuse (pronounced “Beetel-juice”). The bright blue star below the belt is his foot and is called Rigel³. The emergence of the *Waluku* in the east became the basis for determining the beginning of the first *Sasih* in *Wariga*.

² Ammarell, *Cultural Production of Skylore in Indonesia*, 2209.

³ Andrew Fraknoi, et. al, *Astronomy*, (Houston: Rice University, 2017),

In the *Wariga* mentioned the time of appearance of the constellation Orion which marks the beginning of the season of each month. Therefore, it is necessary to test its accuracy, whether the *Wariga* provisions regarding the time of the appearance of the Orion constellation are in accordance with the results of using the Stellarium application, which are as follows:

<i>Masa</i> (Season)	<i>Genah</i> (Place)	<i>Dauh</i> (Hour) in WITA	Result
I (June 22)	<i>Wetan</i> /East	1 (03.36-05.59)	✓
II (August 2)	<i>Wetan</i> /East	1 (03.36-05.59)	✓
III (August 25)	<i>Wetan</i> /East	1 (03.36-05.59)	✓
IV (September 18)	<i>Amner</i> /Above	1 (03.36-05.59)	✓
V (October 13)	<i>Kulon</i> /West	1 (03.36-05.59)	✓
VI (November 9)	<i>Wetan</i> /East	4 (20.24-22.47)	✓
VII (December 22)	<i>Wetan</i> /East	4 (20.24-22.47)	✓
VIII (February)	<i>Amner</i> /Above	4 (20.24-22.47)	✓
IX (March 1)	<i>Kulon</i> /West	4 (20.24-22.47)	✓
X (March 26)	<i>Kulon</i> /West	4 (20.24-22.47)	✓
XI (April 19)	<i>Kulon</i> /West	4 (20.24-22.47)	✓
XII (May 12)	<i>Ngerem</i> /Set	4 (20.24-22.47)	✓

Table 4.1. Orion Appearance Accuracy Using Stellarium Reference

The year used in this accuracy test is 2021 with the consideration that whether the determination of the appearance of *Waluku* or orion in the *Wariga* is in line with today's celestial phenomena. The "Result" column is the result of an accuracy test using the Stellarium reference

which is a sky map application. The check mark “✓” indicates that the appearance of the *Waluku* or orion in the *Wariga* matches the appearance of the current sky according to Stellarium Application.

B. The Accuration of the Beginning Season in Bali *Wariga*

To prove that the Balinese *Wariga* season system is still relevant to the Gregorian year data commonly used today, we attach the conversion of the beginning of the season in the *Wariga* and the beginning of the season in the Gregorian system in year 2021 as follows :

<i>Masa Wariga</i>	Year 2021 (AD)	Season
<i>Masa I</i>	June 22	Dry
<i>Masa II</i>	August 2	Dry
<i>Masa III</i>	August 25	Dry
<i>Masa IV</i>	September 18	Transition rainy
<i>Masa V</i>	October 13	Rainy
<i>Masa VI</i>	November 9	Rainy
<i>Masa VII</i>	December 22	Heavy rain
<i>Masa VIII</i>	February 3	Rainy
<i>Masa IX</i>	March 1	Rainy
<i>Masa X</i>	March 26	Transition dry
<i>Masa XI</i>	April 19	Dry
<i>Masa VII</i>	May 12	Dry

Table 4.2. The Data of Beginning Season between *Wariga* And Gregorian Calendarin year 2021.

The beginning of *Masa* I is June 22, when the position of the Sun in the sky is at the Tropic of Cancer. This time is over and begins to enter *Masa* II on August 2, and so on until *Masa* IV, which starts on September 18, when the position of the Sun is at the zenith. When the position of the Sun is at the Solstice December 21, marks the end of *Masa* VI. This process repeats symmetrically until *Masa* VII on December 22 to *Masa* XII on May 12.

1. Sun Motion's Reference

In general, the start of the season in the *Wariga* system will always fall in June. This is in line with the beginning of the Kaesa month of the Saka calendar (see the Table 4.2). If it is associated with the theory of the seasons in astronomy where the seasons are influenced by the apparent motion of the Sun, then the season system in *Wariga* is in accordance with both the beginning and the end of the season, as follows:

a. Dry Season

The dry season or summer falls in June 21. This is because at this time the position of the Sun is at the farthest point of the Northern Hemisphere, so that in the Northern Hemisphere the Sun will be directly overhead because the position of the Sun is at 23.5° LU. This is in line with the beginning of the seasonal system of *Wariga*, which falls around June 21-22. This period marked by the wind blows from the west, falling leaves and followed by plants starting to flower. Farmer's

activity in this season are burn crop waste and planting crops.

b. Rainy Season

The rainy season falls in December 21. This is because at this time the position of the Sun is farthest in the South (for the Northern Hemisphere), so that in the northernmost hemisphere the Sun will not be seen directly because the position of the Sun is at 23.5° LS. This is in line with the beginning of the seasonal system of *Wariga*, which falls around December 21-22. This period marked by the wind blows from the west, with natural signs of rain and floods. Farmer activities improve rice field bunds.

2. Star Reference

The *Waluku*/Orion constellation plays an important role in determining the growing season. In modern astronomy, the constellation Orion represents a Greek hunter named Orion. This constellation generally consists of 4 main stars that make up the body of the Hunter, namely Betelgeuse, Bellatrix, Saiph and Rigel. In the center of this form are 3 stars that form a straight line, and this is known as the Belt of Orion. Orion's belt consists of 3 main stars, namely Alnitak, Alnilam and Mintaka. Therefore, in this accuracy test used the Mintaka star data as a reference⁴.

⁴ The Sky Live, *Mintaka - δ Orionis (delta Orionis)*, as quoted in <https://theskylive.com/sky/stars/mintaka-delta-orionis-star> retrieved 22 June 2021.

RISE <small>Azimuth: 90.3°</small>	5:43
TRANSIT <small>Max altitude: 82.2°</small>	11:45
SET <small>Azimuth: 269.7°</small>	17:43
RIGHT NOW <small>Mintaka - δ Orionis (delta Orionis) is below the horizon from Singaraja (ID)</small>	

Figure 4.4. Data of Rise, Transit, and Set of Mintaka in June 22, 2021

Wariga accuracy of the start of the season on June 22, using a reference star of the constellation Orion Mintaka, then it is appropriate. In Table 4.1 can be seen that the *Masa* I shows the appearance of the constellation Orion in the hours 3:36 to 05:59 pm. This is in accordance with the rising of the star praying at 05:43 WITA. Therefore, the provisions of the emergence of *Waluku* / Orion by *Wariga* still relevant if the observations in the sky today.

3. BMKG Data Reference

In areas that are categorized as tropical climates, in Indonesia there is two seasonal patterns will be found, namely the rainy and dry seasons which in one year the rainy season is longer than the summer or the summer is longer than the rainy season. The two seasonal patterns found in Indonesia are inseparable from the Indonesian climate. The element of air temperature in Indonesia

throughout the year is almost constant, but the element of rainfall changes greatly and has a major influence on the seasons. In addition, the change of seasons in Indonesia is also influenced by the seasons in Australia and Asia. If it is summer in Asia (June), then Indonesia is experiencing the peak of the dry season. On the other hand, if there is winter in Asia (December) then Indonesia is experiencing the peak of the rainy season.

The Meteorology, Climatology and Geophysics Agency (BMKG) has the ability and authority in Indonesia to predict weather changes and seasonal movements every year. Therefore, BMKG routinely publishes 2 Season Forecast information, there is Rainy Season and Dry Season every year. So in this study, these 2 data were used to be used as a reference in testing the accuracy of the beginning of the season on the Bali *Wariga* system.

a. Dry Season

Normally the shift of seasons in the prediction data for determining the start of the BMKG season for the period 1981-2010, the beginning of the dry season occurs in March III - April II. Meanwhile, the start of the 2021 dry season in the range of April and June 2021 was 198 ZOM or 57.9% of 342 ZOM⁵. If this data is used as a reference, it can be concluded that when compared to the average for 30 years (1981-2010), the

⁵ The data taken is the average dry season data in the province of Bali to facilitate analysis. See BMKG National, *Buku Perkiraan Musim Kemarau 2021*, (Jakarta: Buletin BMKG, 2020): 31.

start of the 2021 dry season in most regions which 197 (57.6%) is predicted to decline⁶. This is in line with the beginning of the dry season of *Wariga*, which falls around May to June.

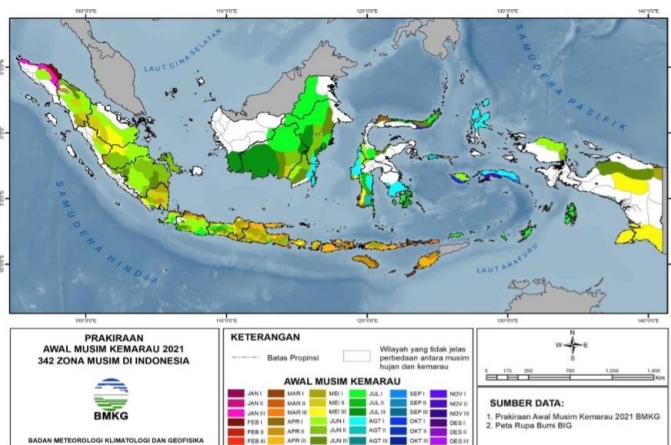


Figure 4.5. Forecast of the 2021 Dry Season by BMKG

b. Rainy Season

Normally the shift of seasons in the prediction data for determining the start of rainy season by the BMKG for the period 1981-2010, occurs in Oktober III – November II. Meanwhile, the start of the 2020/2021 Rainy Season in 342 Seasonal Zones (ZOM) is generally predicted to start in October 2020 at 119 ZOM (34.8%), November 2020 at 131 ZOM (38.3%), and

⁶ BMKG National, *Buku Prakiraan Musim Kemarau 2021*, (Jakarta: Buletin BMKG, 2020): 6.

December 2020 at 56 ZOM (16, 4%)⁷. This is in line with the beginning of the dry season of *Wariga*, which falls around October to December.

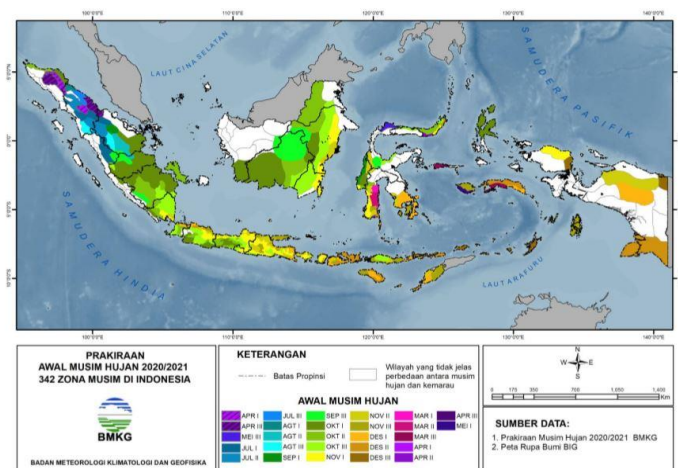


Table 4.6. Forecast of the 2021 Rainy Season by BMKG

From the two references used, it can be concluded that the Bali *Wariga* season system has its advantages and disadvantages, which will be described as follows:

1. Advantages

The *Wariga* season system that uses natural predictions as a reference for its calculations can still be said to be relevant to continue to be used by the

⁷ The data taken is the average dry season data in the province of Bali to facilitate analysis. BMKG National, *Buku Prakiraan Musim Hujan 2021*, (Jakarta: Buletin BMKG, 2020): 53.

community to this day. It has been proven in the previous page, that it is related with two references, namely astronomical (data of the apparent annual movement of the sun) and climatologically (BMKG data).

4. Disadvantages

The seasonal system does not describe the variations that may appear in certain years. For example, due to the emergence of the phenomenon of ENSO (El Nino Southern Oscillation) which is meteorologically expressed in the value of the Southern Oscillation Index (SOI), the El Nino phenomenon which extends the dry season and La Nina extends the rainy season and its influenced by the moonson circulation which causes climate differences.

However, it needs to be reiterated that the season system do is a prediction, not a certainty of the day. Because the seasons, climate and weather really depend on natural conditions.

CHAPTER V

CONCLUSION AND RECOMMENDATION

A. Conclusion

1. The Bali *Wariga* seasonal system can be compared to the seasonal system based on astronomical approaches, such as the annual pseudo cycle of the sun and also the appearance of the constellations.
2. The accuracy of the beginning season of Bali *Wariga* is good because it is close to the season predictions used today, such as the annual pseudo-circulation of the sun, the appearance of stars and also the BMKG which has official authority as a provider of information regarding season predictions in Indonesia.

B. Recommendation

1. There needs to be an adjustment between the method of determining the Bali *Wariga* season and data from BMKG, especially on the phenomenon of ENSO (El Nino Southern Oscillation) and moonson circulation which causes climate differences. This effort is made so that the method in the *Wariga* season system remains relevant to climate

regularity and is accurate to be applied in the current context.

2. There needs to be an in-depth research on how far the accuracy of this wariga season calculation if it is correlated with the current season's phenomenon and also the accuracy of the appearance of constellations or stars directly with field research.

BIBLIOGRAPHY

Book

- AB, W. Simpen. *Pelajaran Dewasa (Wariga)*. Denpasar: Muria, 1987.
- Admiranto, A. Gunawan. *Menjelajahi Bintang, Galaksi, dan Alam Semesta*. Yogyakarta : Kanisius Yogyakarta, 2009.
- Ali, Abdullah Yusuf. *The Holy Quran English Translation of the Meaning and Commentary*. Medina, Saudi Arabia: King Fahd Printing Complex, 1991.
- Ammarell, Gene. Tsing, Anna Lowenhaupt. *Cultural Production of Skylore in Indonesia*. New York: Springer Science & Business Media, 2015.
- Ardhana, I. B. Supart. *Pokok-Pokok Wariga*. Surabaya: Paramita, 2006.
- Ariana, et.al. *Ala Ayuning Dewasa, Ketut Bangbang Gde Rawi (Sebuah Canangsari)*. Denpasar: Penerbit ESBE Buku, 2016.
- Aryana, I B Putra Manik. *Dasar Wariga : Kearifan Alam Dalam Sistem Tarikh Bali*. Denpasar: Bali Aga, 2009.
- Azhari, Susiknan. *Pembaharuan Pemikiran Hisab Di Indonesia, Studi Atas Pemikiran Sa'adoeddin Djambek*. Yogyakarta: Pustaka Pelajar, 2002.
- Bakker, Anton. *Kosmologi Metafisik*. Yogyakarta : Yayasan Fakultas Filsafat UGM , 1970.

- Bashori, Muh. Hadi. *Penanggalan Islam : Peradaban Tanpa Penanggalan, Inikah Pilihan Kita*. Jakarta: PT Elex Media Komputindo, 2013.
- BMKG Nasional. *Buku Perkiraan Musim Hujan 2021*. Jakarta: Buletin BMKG, 2020.
- _____. *Buku Perkiraan Musim Kemarau 2021*. Jakarta: Buletin BMKG, 2020.
- Butar, Arwin Juli Rakhmadi. *Kalender, Sejarah dan Arti Pentingnya dalam Kehidupan*. Semarang: CV. Bisnis Mulia Konsultama, 2014.
- Darsono, Ruswa. *Penanggalan Islam (Tinjauan Sistem, Fiqih dan Hisab Penanggalan)*. Yogyakarta: Labda Press, 2010.
- DeMillo, Rob. *How Weather Works*. California: Ziff-Davis Press, 2009.
- Djamaluddin, Thomas. *Menggagas Fiqih Astronomis (Telaah Hisab Rukyah dan Pencarian Solusi Perbedaan Hari Raya*. Bandung : Kaki Langit, 2005.
- Fathurrohman, *Cara Mudah Belajar Ilmu Falak*. Jombang: Muhipress, 2012.
- Fisher, Stephen. Bobrow, Jerry. *Cliffs Notes CSET: Multiple Subjects with CD-ROM*. Boston: Houghton Mifflin Harcourt, 2012.
- Guweng, I Ketut. *Sarining Wariga*. Publisher not identified.

- Hadikusuma, Hilman. *Antropologi Agama: Pendekatan Budaya Terhadap Aliran Kepercayaan, Agama Hindu, Budha, Kong Hu Cu di Indonesia*. Bandung: Citra Aditya Bakti, 2009.
- Hambali, Slamet. *Almanak Sepanjang Masa*. Semarang: Program Pascasarjana IAIN Walisongo Semarang, 2011.
- _____. *Pengantar Ilmu Falak (Menyimak Proses Pembentukan Alam Semesta)*. Banyuwangi: Bismillah Publisher, 2012.
- Hofstede, Geert. *Cultures and Organizations: Software of the Mind*. London: Harper Collins Business.
- Ilyas, Mohammad. *Astronomy of Islamic Calendar*. Kuala Lumpur: A.S Noordeen, 1997.
- _____. *The Quest for a United Islamic Calendar*. Malaysia: International Islamic Calendar Program, 2000.
- Izzuddin, Ahmad. *Ilmu Falak Praktis*. Semarang : PT Pustaka Rizki Putra, 2012.
- _____. *Sistem Penanggalan*. Semarang: Kerya Abadi Jaya, 2015.
- Jayusman. “Aspek Ketauhidan Dalam Sistem Kalender Hijriah”, *Al-Adyan: Jurnal Studi Lintas Agama*, vol 5, 2010.
- Kemenag RI. *Al-Qur'an dan Tafsirnya*. Jakarta: PT . Sinergi Pustaka Indonesia, 2012.

- Khazin, Muhyiddin, *Ilmu Falak: Dalam Teori dan Praktek*. Yogyakarta: Buana Pustaka, 2004.
- Laksono, Paschalis Maria. *Cerita Rakyat Dari Lampung 2*. Jakarta: Prenada, 2007.
- Lontaan, J. U, *Sejarah Hukum Adat-Istiadat Kalimantan Barat*. Pemda Kalimantan Barat, 1975.
- Mardalis. *Metode Penelitian, Suatu Pendekatan Proposal*. Jakarta: Bumi Aksara, 2010.
- Mostafa, Agus. *Jangan Asal Ikut-ikutan Hisab & Rukyat*. Surabaya: Padma Press, 2013.
- Namayuda, I B. *Fungsi Wariga di Bali*. Denpasar: Fakultas Agama dan Kebudayaan IHD, 1980.
- Pannekoek, Anton. *A History of Astronomy*. New York : Dover Publications, Inc, 1961.
- Poesponegoro, Marwati Djoened and Notosusanto, Nugroho. *Sejarah Nasional Indonesia, I, II, III, IV, V*. Jakarta: Balai Pustaka, 1998.
- Pusat Survei Sumberdaya Alam Darat, *Prosiding Respons Cepat Terhadap Bencana Alam*. Jakarta: Badan Koordinasi Survei dan Pemetaan Nasional, 2007.
- Rafi'i, Suryatna. *Meteorologi dan Klimatologi*. Bandung: Angkasa, 1995.
- Rajaram, Navaratna Srinivasa. *Vedic Aryan and The Origin of Civilization*. India : The Voice of India, 1995.

- S.V.D, J Kersten. *Bahasa Bali; Kamus Bahasa Lumrah*. Flores: Nusa Indah, 1984.
- Setyanto, Hendro. *Membaca Langit*. Jakarta : al-Guraba, 2008.
- Simanjuntak, Batara Sangti. *Sejarah Batak*. Medan: K. Sianipar Company, 1978.
- Simpem, *Pelajaran Dewasa (Wariga)*. Denpasar : Toko Buku Muria, 1987.
- Slamet, Hambali. *Almanak Sepanjang Masa*. Semarang: Program Pascasarjana IAIN Walisongo Semarang, 2011.
- Sucahyono, Dedi. Ribudiyanto, Kuku. *Cuaca Dan Iklim Ekstrim Di Indonesia*. Jakarta: Puslitbang BMKG, 2013.
- Sugiyono. *Metode Penelitian Kuantitatif, Kualitatif dan R & D*. Bandung: Alfabeta, 2012.
- Suryanto, Wiwit. Lutfian, Alutsyah. *Pengantar Meteorologi*. Yogyakarta: Gadjah Mada University Press, 2019.
- Susiknan Azhari, *Ensiklopedi Hisab Rukyah*, (Yogyakarta: Pustaka Pelajar, 2008), 119.
- Suyanto, Bagong. *Metode Penelitian Sosial*. Jakarta : Kencana, 2005.
- Sztompka, Piotr. *The Sociology Of Social Change*, translated by Alimandan, *Sosiologi Perubahan Sosial*. Jakarta: Prenada, 2007.

Titib, I Made. *Veda Sabda Suci: Pedoman Praktis Kehidupan*. Surabaya: Paramita, 1996.

Wirjohamidjojo, Soerjadi. Swarinoto, Yunus S. *Praktek Meteorologi Pertanian*. Jakarta: BMKG, 2007.

Younce, William C. *Indonesia: Issues, Historical Background and Bibliography*. New York: Nova Publishers, 2001.

Articles

Bhandes, Asthadi Mahendra. "The Implementation Of The *Wariga Dewasa* On Panca Yajña Ceremony In Mataram City", *International Journal of Hindu Science an Religious Studies*, vol. 3, 2019.

Fauzi, Ahmad. "Almanak Menara Kudus: Study of *Ḥisāb* Results in 1990 until 2019", *Al-Ahkam*, vol 29, 2019.

Hasanudin, Maulana. "The Role of Judges in Dealing with Community Development", *Walisongo Law Review (Walrev)*, vol 2, 2020.

Ilyas, Mohammad. "Lunar Crescent Visibility Criterion and Islamic Calendar", *Quarterly Journal*, vol. 3, 1994.

Khavrus, Vyacheslav. Shelevytsky, Ihor. "Geometry and The Physics of Seasons", *Physics Education*, vol. 47, 2012.

- Pramod, Singh et., al, “Critical Review of Ritu (Season) With Special Reference to Current Research”, *International Journal of Research*, vol. 3, 2012.
- Prawira, I Putu Cahya., et. al., “Pengembangan Aplikasi Kalender Saka Bali pada Sistem Operasi Machintos”, *Menara Penelitian Akademika Teknologi Informasi, Program Studi Teknologi Informasi, Fakultas Teknik Universitas Udayana* vol. 3, 2015.
- Prawira, I Putu Cahya, et.al, “Pengembangan Aplikasi Kalender Saka Bali Pada Sistem Operasi Machintos”, *Journal Merpati*, vol. 3, 2015.
- Proudfoot, Ian. “In Search for Lost Time Javanese and Balinese Understanding of The Indic Calendar”, *Bijdragen tot de Taal-, Land- en Volkenkunde*, vol. 163, 2018.
- Ramdhani, Fajri Zulia. “Eksistensi Kalender Bali dalam Kultur Sosial Masyarakat Multireligius Bali”, *Religious: Jurnal Studi Agama-Agama dan Lintas Budaya*, vol. 4, 2020.
- Riza, Muhammad Himmatur and Minani, Nihayatul. “The Effect Of El Nino And La Nina On The Intensity Of Determining Qibla Direction”, *Al-Hilal: Journal of Islamic Astronomy*, vol. 3, 2021.
- Suamba, I. B. P. and Mudana, I. G. “Time in rituals of Javanese-Saivism as preserved in Bali”, *Journal of Physics: Conference Series*, vol. 953, 2018.
- Syam, Hikmatul Adhiyah The Essentiality Of The Nusantara Traditional Calendar, *Al-Hilal: Journal of Islamic Astronomy*, vol. 3, 2021.

Wisnubroto, Sukardi. “Pengenalan Waktu Tradisional *Wariga* Menurut Jabaran Meteorologi dan Pemanfaatannya”, *Jurnal Agromet*, vol. 13, 1998.

Thesis

Awaludin, Muhammad. “Sistem Musim Kalender Rowot Sasak Perspektif Astronomi : Studi Kasus di Desa Kidang Lombok Tengah”, *Thesis*, UIN Walisongo Semarang, 2017.

Faizah, Isniyatin. “Studi Komparatif Sistem Penanggalan Jawa Pranata Mangsa dan Sistem Penanggalan Syamsiah yang Berkaitan dengan Sistem Musim”, *Undergraduate Thesis*, UIN Walisongo Semarang, 2014.

Ferza, Aditya Putra. “Simulasi Pengamatan Dan Pengenalan Rasi Bintang Dan Karakteristiknya Dengan Menggunakan Teknologi Google Cardboard”, *Undergraduate Thesis*, Institut Teknologi Sepuluh Nopember, Surabaya, 2016.

Firdaus, Janatun. “Analisis Penanggalan Sunda dalam Tinjauan Astronomi”, *Undergraduate Thesis*, IAIN Walisongo Semarang, 2013.

Website

Astronomical Applications Department US, *Naval Observatory Earth's Seasons and Apisides*, <https://www.weather.gov/media/ind/seasons.pdf> retrieved 25 March 2021.

- BMKG Denpasar Wilayah III, *Daftar Istilah Musim*, <http://balai3.denpasar.bmkg.go.id/daftar-istilah-musim/> retrieved 2 April 2021.
- Encyclopedia. “Sky Heaven As Hierophany”, <https://www.encyclopedia.com/environment/encyclopedias-almanacs-transcripts-and-maps/sky-heavens-hierophany>
- Merriam-Webster Dictionary, <https://www.merriam-webster.com> retrieved 20 March 2021.
- Partosuwiryo, Suwarman. *Pranata Mangsa Sebagai Alternatif Pedoman Untuk Penangkapan Ikan Di Samodera Hindia Selatan Daerah Istimewa Yogyakarta*. https://nanopdf.com/download/pranata-mangsa-sebagai-alteratif-pedoman-untuk_pdf, retrieved 9 April 2021.
- Purana Vedas, *Vedic Astronomy*. <https://www.puranavedas.com/vedic-astronomy/> retrieved 4 April 2021.
- Schroeder, Daniel V. “The Sun and the Seasons”, <https://physics.weber.edu/schroeder/ua/SunAndSeasons.html>, retrieved 11 March 2021.
- The Sky Live. “Mintaka - δ Orionis (delta Orionis)”. <https://theskylive.com/sky/stars/mintaka-delta-orionis-star> retrieved 22 June 2021.

ATTACHMENT

Attachment 1 INTERVIEW QUESTION

Interviewee : Mrs. Luh Made Ari Chandra Yuni, S.Pd. and
Mr. I Made Yuda Asmara, S.Pd.H., M.Pd., Gr.
Interviewer : Ayu Fitri Damayanti
Via : WhatsApp Call

1. What do you think about *Wariga* is and how is it used?
2. How does *Wariga* Bali determine or predict the season?
3. So, in determining the seasons has anything to do with astronomy?
4. Is the *Wariga* system still in use today?
5. Is the use of *Wariga* only in Bali or are there other people who use this system?

Attachment 2 ORION BASED SASIH EMERGENCE OF EACH PERIOD OR SEASON USING STELLARIUM APPLICATION

Masa I



Masa II



Masa III



Masa IV



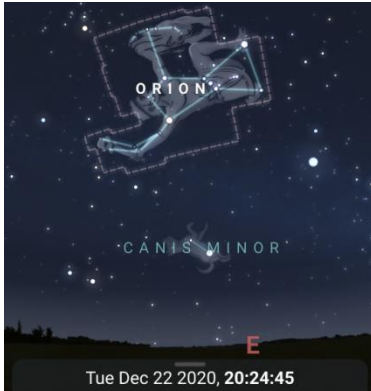
Masa V



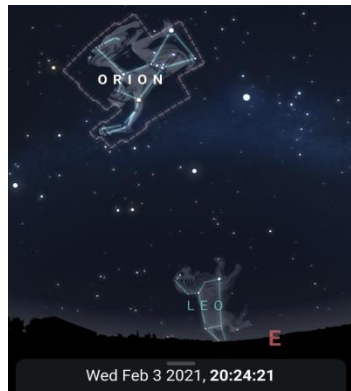
Masa VI



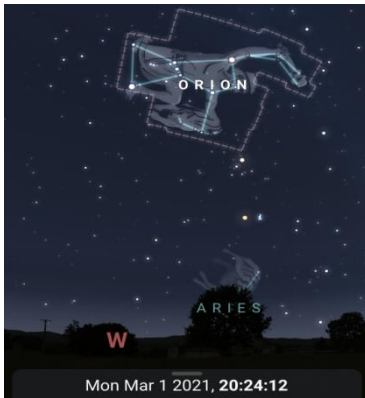
Masa VII



Masa VIII



Masa IX



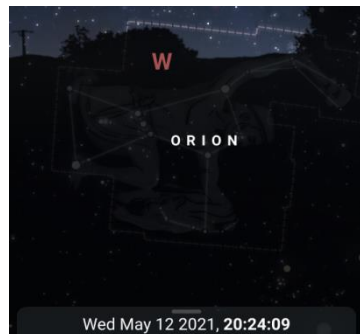
Masa X



Masa XI



Masa XII



Attachment 3 MASA DATE OR SEASON ON BALI CALENDAR YEAR 2021

I JANUARI 2021		SAKA 1942	PRANATA MASA: 166
WUKU		SAKA 1942	PRANATA MASA: 166
MINGGU Redite Sunday Nahayobi Sing Chi Kék	KAPTU 3 3 Redite Sunday Nahayobi Sing Chi Kék SATO	KAPTU 10 10 Pawon Monday Gatuyobi Sing Chi Kék PATRA	KAROLU 17 17 Wang Tuesday Kiyobi Sing Chi Kék WONG
SENIN C o m a Monday Gatuyobi Sing Chi Kék	KAPTU 4 4 Pawon Monday Gatuyobi Sing Chi Kék PATRA	KAPTU 11 11 Wang Tuesday Kiyobi Sing Chi Kék WONG	KAROLU 18 18 Wang Tuesday Kiyobi Sing Chi Kék WONG
SELASA Anggara Tuesday Kiyobi Sing Chi Ei	KAPTU 5 5 Pawon Monday Gatuyobi Sing Chi Kék PATRA	KAPTU 12 12 Wang Tuesday Kiyobi Sing Chi Kék WONG	KAROLU 19 19 Wang Tuesday Kiyobi Sing Chi Kék WONG
RABU B e d a Wednesday Suyobi Sing Chi San	KAPTU 6 6 Pawon Monday Gatuyobi Sing Chi Kék PATRA	KAPTU 13 13 Wang Tuesday Kiyobi Sing Chi Kék WONG	KAROLU 20 20 Wang Tuesday Kiyobi Sing Chi Kék WONG
KAMIS Wraspati Thursday Mikuyobi Sing Chi She	KAPTU 7 7 Pawon Monday Gatuyobi Sing Chi Kék PATRA	KAPTU 14 14 Wang Tuesday Kiyobi Sing Chi Kék WONG	KAROLU 21 21 Wang Tuesday Kiyobi Sing Chi Kék WONG
JUMAT Sukra Friday Kiyobi Sing Chi U	KAPTU 8 8 Pawon Monday Gatuyobi Sing Chi Kék PATRA	KAPTU 15 15 Wang Tuesday Kiyobi Sing Chi Kék WONG	KAROLU 22 22 Wang Tuesday Kiyobi Sing Chi Kék WONG
SABTU Saniscara Saturday Doyobi Sing Chi Liook	KAPTU 9 9 Pawon Monday Gatuyobi Sing Chi Kék PATRA	KAPTU 16 16 Wang Tuesday Kiyobi Sing Chi Kék WONG	KAROLU 23 23 Wang Tuesday Kiyobi Sing Chi Kék WONG
INGKEL	SATO	MINA	MANUK
KALENDER "CAKABALI" LENGKAP			

II FEBRUARI 2021		SAKA 1940	PRANATA MASA: 166
WUKU		SAKA 1940	PRANATA MASA: 166
MINGGU Redite Sunday Nahayobi Sing Chi Kék	KAROLU 7 7 Redite Sunday Nahayobi Sing Chi Kék TARU	KAROLU 14 14 Wang Tuesday Kiyobi Sing Chi Kék WONG	KAROLU 21 21 Wang Tuesday Kiyobi Sing Chi Kék WONG
SENIN C o m a Monday Gatuyobi Sing Chi Kék	KAROLU 8 8 Pawon Monday Gatuyobi Sing Chi Kék PATRA	KAROLU 15 15 Wang Tuesday Kiyobi Sing Chi Kék WONG	KAROLU 22 22 Wang Tuesday Kiyobi Sing Chi Kék WONG
SELASA Anggara Tuesday Kiyobi Sing Chi Ei	KAROLU 9 9 Pawon Monday Gatuyobi Sing Chi Kék PATRA	KAROLU 16 16 Wang Tuesday Kiyobi Sing Chi Kék WONG	KAROLU 23 23 Wang Tuesday Kiyobi Sing Chi Kék WONG
RABU B e d a Wednesday Suyobi Sing Chi San	KAROLU 10 10 Pawon Monday Gatuyobi Sing Chi Kék PATRA	KAROLU 17 17 Wang Tuesday Kiyobi Sing Chi Kék WONG	KAROLU 24 24 Wang Tuesday Kiyobi Sing Chi Kék WONG
KAMIS Wraspati Thursday Mikuyobi Sing Chi She	KAROLU 11 11 Pawon Monday Gatuyobi Sing Chi Kék PATRA	KAROLU 18 18 Wang Tuesday Kiyobi Sing Chi Kék WONG	KAROLU 25 25 Wang Tuesday Kiyobi Sing Chi Kék WONG
JUMAT Sukra Friday Kiyobi Sing Chi U	KAROLU 12 12 Pawon Monday Gatuyobi Sing Chi Kék PATRA	KAROLU 19 19 Wang Tuesday Kiyobi Sing Chi Kék WONG	KAROLU 26 26 Wang Tuesday Kiyobi Sing Chi Kék WONG
SABTU Saniscara Saturday Doyobi Sing Chi Liook	KAROLU 13 13 Pawon Monday Gatuyobi Sing Chi Kék PATRA	KAROLU 20 20 Wang Tuesday Kiyobi Sing Chi Kék WONG	KAROLU 27 27 Wang Tuesday Kiyobi Sing Chi Kék WONG
INGKEL	WONG	SATO	MANUK
KALENDER "CAKABALI" LENGKAP			

III MARET 2021		SAKA 1942/1943	PRANATA MASA: 166
WUKU		SAKA 1942/1943	PRANATA MASA: 166
MINGGU Redite Sunday Nahayobi Sing Chi Kék	KAROLU 7 7 Redite Sunday Nahayobi Sing Chi Kék PATRA	KAROLU 14 14 Wang Tuesday Kiyobi Sing Chi Kék WONG	KAROLU 21 21 Wang Tuesday Kiyobi Sing Chi Kék WONG
SENIN C o m a Monday Gatuyobi Sing Chi Kék	KAROLU 8 8 Pawon Monday Gatuyobi Sing Chi Kék PATRA	KAROLU 15 15 Wang Tuesday Kiyobi Sing Chi Kék WONG	KAROLU 22 22 Wang Tuesday Kiyobi Sing Chi Kék WONG
SELASA Anggara Tuesday Kiyobi Sing Chi Ei	KAROLU 9 9 Pawon Monday Gatuyobi Sing Chi Kék PATRA	KAROLU 16 16 Wang Tuesday Kiyobi Sing Chi Kék WONG	KAROLU 23 23 Wang Tuesday Kiyobi Sing Chi Kék WONG
RABU B e d a Wednesday Suyobi Sing Chi San	KAROLU 10 10 Pawon Monday Gatuyobi Sing Chi Kék PATRA	KAROLU 17 17 Wang Tuesday Kiyobi Sing Chi Kék WONG	KAROLU 24 24 Wang Tuesday Kiyobi Sing Chi Kék WONG
KAMIS Wraspati Thursday Mikuyobi Sing Chi She	KAROLU 11 11 Pawon Monday Gatuyobi Sing Chi Kék PATRA	KAROLU 18 18 Wang Tuesday Kiyobi Sing Chi Kék WONG	KAROLU 25 25 Wang Tuesday Kiyobi Sing Chi Kék WONG
JUMAT Sukra Friday Kiyobi Sing Chi U	KAROLU 12 12 Pawon Monday Gatuyobi Sing Chi Kék PATRA	KAROLU 19 19 Wang Tuesday Kiyobi Sing Chi Kék WONG	KAROLU 26 26 Wang Tuesday Kiyobi Sing Chi Kék WONG
SABTU Saniscara Saturday Doyobi Sing Chi Liook	KAROLU 13 13 Pawon Monday Gatuyobi Sing Chi Kék PATRA	KAROLU 20 20 Wang Tuesday Kiyobi Sing Chi Kék WONG	KAROLU 27 27 Wang Tuesday Kiyobi Sing Chi Kék WONG
INGKEL	MINA	MANUK	WONG
KALENDER "CAKABALI" LENGKAP			

IV APRIL 2021		SAKA 1943	PRANATA MASA: 166
WUKU		SAKA 1943	PRANATA MASA: 166
MINGGU Redite Sunday Nahayobi Sing Chi Kék	KAROLU 4 4 Redite Sunday Nahayobi Sing Chi Kék PATRA	KAROLU 11 11 Wang Tuesday Kiyobi Sing Chi Kék WONG	KAROLU 18 18 Wang Tuesday Kiyobi Sing Chi Kék WONG
SENIN C o m a Monday Gatuyobi Sing Chi Kék	KAROLU 5 5 Pawon Monday Gatuyobi Sing Chi Kék PATRA	KAROLU 12 12 Wang Tuesday Kiyobi Sing Chi Kék WONG	KAROLU 19 19 Wang Tuesday Kiyobi Sing Chi Kék WONG
SELASA Anggara Tuesday Kiyobi Sing Chi Ei	KAROLU 6 6 Pawon Monday Gatuyobi Sing Chi Kék PATRA	KAROLU 13 13 Wang Tuesday Kiyobi Sing Chi Kék WONG	KAROLU 20 20 Wang Tuesday Kiyobi Sing Chi Kék WONG
RABU B e d a Wednesday Suyobi Sing Chi San	KAROLU 7 7 Pawon Monday Gatuyobi Sing Chi Kék PATRA	KAROLU 14 14 Wang Tuesday Kiyobi Sing Chi Kék WONG	KAROLU 21 21 Wang Tuesday Kiyobi Sing Chi Kék WONG
KAMIS Wraspati Thursday Mikuyobi Sing Chi She	KAROLU 8 8 Pawon Monday Gatuyobi Sing Chi Kék PATRA	KAROLU 15 15 Wang Tuesday Kiyobi Sing Chi Kék WONG	KAROLU 22 22 Wang Tuesday Kiyobi Sing Chi Kék WONG
JUMAT Sukra Friday Kiyobi Sing Chi U	KAROLU 9 9 Pawon Monday Gatuyobi Sing Chi Kék PATRA	KAROLU 16 16 Wang Tuesday Kiyobi Sing Chi Kék WONG	KAROLU 23 23 Wang Tuesday Kiyobi Sing Chi Kék WONG
SABTU Saniscara Saturday Doyobi Sing Chi Liook	KAROLU 10 10 Pawon Monday Gatuyobi Sing Chi Kék PATRA	KAROLU 17 17 Wang Tuesday Kiyobi Sing Chi Kék WONG	KAROLU 24 24 Wang Tuesday Kiyobi Sing Chi Kék WONG
INGKEL	MINA	MANUK	WONG
KALENDER "CAKABALI" LENGKAP			

V MEI 2021		SAKA 1943 SAGI SADIA ngguyu KARO SADIA ngguyu KARO 10M Pangrayung 11	PRANATA MASA 166 / 167 MASA 11 M.A.S.A. 10 / 11 12 Mei - 21 Juni
WUKU L...+... Mandir Sando Nichohe Sing Chi Rok	13 KESAK 14 BEKASA 15 PUSAT	16 ANEKA 17 ANEKA 18 ANEKA	19 ANEKA 20 ANEKA 21 ANEKA
MINGGU Redite Sunday Nichohe Sing Chi Rok	2 3	9 10	16 17
SENIN C o m a Monday Gecusoh Sing Chi Ik	4 5	11 12	18 19
SELASA Anggara Tuesday Kayohi Sing Chi Ei	6 7	13 14	20 21
RABU B u d a Wednesday Suyohi Sing Chi San	8 9	15 16	22 23
KAMIS Wraspati Thursday Mikoyohi Sing Chi She	10 11	17 18	24 25
JUMAT Sakra Friday Kinyohi Sing Chi U	12 13	19 20	26 27
SABTU Sanicara Saturday Doyohi Sing Chi Lioek	14 15	21 22	28 29
INGKEL WONG KALENDER "CAKABALI" LENGKAP	SATO MINA TARU	FAKSI MIRA TARU	WONG MIRA TARU

VI JUNI 2021		SAKA 1943 SAGI SADIA ngguyu KARO SADIA ngguyu KARO 10M Pangrayung 11	PRANATA MASA 166 / 167 MASA 11 M.A.S.A. 10 / 11 12 Mei - 21 Juni
WUKU L...+... Mandir Sando Nichohe Sing Chi Rok	13 KESAK 14 BEKASA 15 PUSAT	16 ANEKA 17 ANEKA 18 ANEKA	19 ANEKA 20 ANEKA 21 ANEKA
MINGGU Redite Sunday Nichohe Sing Chi Rok	6 7	13 14	20 21
SENIN C o m a Monday Gecusoh Sing Chi Ik	8 9	15 16	22 23
SELASA Anggara Tuesday Kayohi Sing Chi Ei	10 11	17 18	24 25
RABU B u d a Wednesday Suyohi Sing Chi San	12 13	19 20	26 27
KAMIS Wraspati Thursday Mikoyohi Sing Chi She	14 15	21 22	28 29
JUMAT Sakra Friday Kinyohi Sing Chi U	16 17	23 24	30 31
SABTU Sanicara Saturday Doyohi Sing Chi Lioek	18 19	25 26	
INGKEL WONG KALENDER "CAKABALI" LENGKAP	BUKU MINA TARU	FAKSI MIRA TARU	WONG MINA TARU

VII JULI 2021		SAKA 1943 SAGI SADIA ngguyu KARO SADIA ngguyu KARO 10M Pangrayung 11	PRANATA MASA 166 / 167 MASA 12 / 13 M.A.S.A. 10 / 11 12 Mei - 21 Juni
WUKU L...+... Mandir Sando Nichohe Sing Chi Rok	13 KESAK 14 BEKASA 15 PUSAT	16 ANEKA 17 ANEKA 18 ANEKA	19 ANEKA 20 ANEKA 21 ANEKA
MINGGU Redite Sunday Nichohe Sing Chi Rok	4 5	11 12	18 19
SENIN C o m a Monday Gecusoh Sing Chi Ik	6 7	13 14	20 21
SELASA Anggara Tuesday Kayohi Sing Chi Ei	8 9	15 16	22 23
RABU B u d a Wednesday Suyohi Sing Chi San	10 11	17 18	24 25
KAMIS Wraspati Thursday Mikoyohi Sing Chi She	12 13	19 20	26 27
JUMAT Sakra Friday Kinyohi Sing Chi U	14 15	21 22	28 29
SABTU Sanicara Saturday Doyohi Sing Chi Lioek	16 17	23 24	30 31
INGKEL WONG KALENDER "CAKABALI" LENGKAP	MANUK TARU	BUKU MIRA TARU	SATO MINA TARU

VIII AGUSTUS 2021		SAKA 1943 SAGI SADIA ngguyu KARO SADIA ngguyu KARO 10M Pangrayung 11	PRANATA MASA 166 / 167 MASA 12 / 13 M.A.S.A. 10 / 11 12 Mei - 21 Juni
WUKU L...+... Mandir Sando Nichohe Sing Chi Rok	13 KESAK 14 BEKASA 15 PUSAT	16 ANEKA 17 ANEKA 18 ANEKA	19 ANEKA 20 ANEKA 21 ANEKA
MINGGU Redite Sunday Nichohe Sing Chi Rok	1 2	8 9	15 16
SENIN C o m a Monday Gecusoh Sing Chi Ik	3 4	10 11	17 18
SELASA Anggara Tuesday Kayohi Sing Chi Ei	5 6	12 13	19 20
RABU B u d a Wednesday Suyohi Sing Chi San	7 8	14 15	21 22
KAMIS Wraspati Thursday Mikoyohi Sing Chi She	9 10	16 17	23 24
JUMAT Sakra Friday Kinyohi Sing Chi U	11 12	18 19	25 26
SABTU Sanicara Saturday Doyohi Sing Chi Lioek	13 14	20 21	27 28
INGKEL WONG KALENDER "CAKABALI" LENGKAP	MINA TARU	MANUK TARU	SATO MINA TARU

Attachment 4


ANNOTATION LETTERS

The undersigned below :

Name : Luh Made Ari Chandra Yuni, S.Pd.
Place, Date Birth : Klungkung, June 6, 1995
Age : 26
Last Education : Bachelor Degree (S1)
Occupation : Teacher
Explain truthfully that,
Name : Ayu Fitri Damayanti
NIM : 1702046094
Faculty/Major : Syari'ah and Law/Islamic Astronomy
Address : Life Skill Daarun Najaah Islamic
Boarding School, Bukit Beringin Lestari
Barat Street, Kav. C131, Wonosari,
Ngaliyan, Semarang.

Really has done an interview in order to complete the necessary data for the undergraduate thesis under the title : **“THE BALI WARIGA CALCULATION SYSTEM: AN ANALYSIS OF SEASON DETERMINATION IN ASTRONOMIC PERSPECTIVE”**

Acknowledged,



(Luh Made Ari Chandra
Yuni, S.Pd.)

ANNOTATION LETTERS

The undersigned below :

Name : I Made Yuda Asmara, S.Pd.H., M.Pd., Gr.
 Place, Date Birth : Karangasem, September 12, 1988
 Age : 32
 Last Education : Magister Degree (S2)
 Occupation : Lecturer of STKIP Agama Hindu
 Amlapura

Explain truthfully that,

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 NIM : 1702046094
 Faculty/Major : Syari'ah and Law/Islamic Astronomy
 Address : Life Skill Daarun Najaah Islamic
 Boarding School, Bukit Beringin Lestari
 Barat Street, Kav. C131, Wonosari,
 Ngaliyan, Semarang.

Really has done an interview in order to complete the necessary data for the undergraduate thesis under the title : **“THE BALI WARIGA CALCULATION SYSTEM: AN ANALYSIS OF SEASON DETERMINATION IN ASTRONOMIC PERSPECTIVE”**

Acknowledged,



(I Made Yuda Asmara, S.Pd.H.,
 M.Pd., Gr.)

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ACADEMIC QUALIFICATIONS

- A. Formal Academics
 - 1. Al-Ikhlas Kindergarden School (2005)
 - 2. Taman 3 State Elementary School (2011)
 - 3. Mardlatillah Islamic Junior High School (2014)
 - 4. Diponegoro Islamic Senior High School (2017)
 - 5. State Islamic University of Walisongo (*ongoing*)
- B. Non-Formal Academics
 - 1. Mahesa English Course, Pare, Kediri (2019)
 - 2. Life Skill Daarun Najaah Boarding School (*ongoing*)
- C. Organization Experience
 - 1. OSMAD of Diponegoro Boarding School
 - 2. CSSMoRA Walisongo
 - 3. KEMPO Walisongo
 - 4. Click's FSH