

THE DEVELOPMENT OF FOOD SECURITY MODEL BASED ON SUBAK SYSTEM IN BALI

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ABSTRAK

Ketahanan pangan yang berbasis sistem subak, mempunyai arti penting dalam kehidupan rumah tangga petani di Bali. Sebab subak sebagai kearifan lokal dan model sosial sangat potensial dimanfaatkan dalam proses pembangunan nasional, termasuk sebagai sebuah model pengembangan program ketahanan pangan. Tujuan penelitian untuk (1) mengetahui indeks ketahanan pangan; dan (2) menemukan model pengembangan ketahanan pangan berbasis sistem subak di Bali.

Penelitian dilakukan pada dua subak yang berbeda karakter kegiatannya yang dipilih secara sengaja, yakni Subak Lodtunduh, Gianyar memiliki koperasi tani dan Subak Anggabaya, Denpasar belum memiliki koperasi tani. Jumlah responden pada masing-masing subak sebanyak 30 orang, yang ditentukan secara acak.

Hasil penelitian menunjukkan bahwa indeks ketahanan pangan rumah tangga petani di Subak Lodtunduh (memiliki koperasi tani) lebih baik daripada di Subak Anggabaya (belum memiliki koperasi tani). Indeks ketahanan pangan di Subak Lodtunduh termasuk "tahan" sedangkan di Subak Anggabaya termasuk "kurang tahan". Berdasarkan kenyataan ini, kiranya perlu diperkenalkan koperasi tani pada semua subak yang belum memiliki koperasi tani, dalam upaya meningkatkan ketahanan pangan rumah tangga petani di Bali.

Kata kunci : model pengembangan, ketahanan pangan, sistem subak

ABSTRACT

Food security based on *subak* system, has an important role in farmer household life in Bali. This is because *subak* as local knowledge and social model are potential to be utilized in the process of national development, including as a model of food security program development. This research aims to (1) find out food security index; and (2) develop model of food security development based on *subak* system in Bali.

The research was conducted at two *subak* that have different characteristics chosen purposively, i.e Subak Lodtunduh, Gianyar which has an farmer cooperative and Subak Anggabaya, Denpasar which does not have farmer cooperative. Number of respondents selected in each *subak* was 30 using a random sampling method.

Result of the research indicates that the food security index at farmer household level at Subak Lodtunduh (own agricultural cooperative) is better than that of Subak Anggabaya (no agricultural cooperative). Food security index at Subak Lodtunduh is categorized as "secure", while "less secure" for Subak Anggabaya. Based on this finding, it is suggested to introduce agricultural cooperative to those *subak* which do not have agricultural cooperative yet, in order to increase food security at farmer household level in Bali.

Keywords: development model, food security, subak system

INTRODUCTION

Background

Food security as national program needs obtaining a support of community with the entire capability at hand because this program has an implication to national security. To realize a food security could be carried out by developing food production system based on resources, institution and local culture, among them, *subak* system in Bali as indigenous wisdom and forceful social asset in Bali could be taken advantage as a development model of food security program.

All provinces across Indonesia, including Bali Province should attain food security. Policy of developmental program of Bali in five years to come were as follows: (1)

To develop food security system based on the capability of production, food diversification, institution and local culture, (2) To develop agribusiness having orientation by development of local leading and competitive products and superiority of comparative natural resources (Bali Agency for Regional Development). Food security is defined as the satisfying condition of food need for household reflected in the stock of adequate food in terms of both quantity and quality, secured, even and affordable (Government Regulation No. 68/2002).

As an institution having socio-cultural characteristics, *subak* has a power or wisdom and weakness (Pusposutardjo and Wardana, 1997; and Windia, 2008). Some of those indigenous wisdoms are organization having good governance, flexibility, having capability of absorbing

or adopting technology developing around them and having capability of absorbing the culture developing in surrounding community. This force denotes an indigenous wisdom and social asset that can shore up the food security program sustainably. Meanwhile, the weakness of *subak* as an institution having a socio-cultural characteristic is that it could not resist the intervention from external parties. This incapability is reflected in the large number of land undergoing transfer of function to sectors beyond agriculture like to building for hotel and building for housing complex. In addition, there is relatively a large amount of withdrawing of irrigation water by other sectors such as Municipal Waterworks (PDAM), hotels and other tourism components.

Concerning with the weakness owned by *subak*, thing needs paying attention is the development of socio-economic activities on such *subaks* as a model for developing food security. The model based on indigenous wisdom and sturdy social asset will raise a strong model and be able to create sustainable food security.

Objectives of Research

Based on such background, this research is meant to (1) to measure the index of food security at the area of research and (2) to discover a developmental model of food security based on *subak* system in Bali.

RESEARCH METHOD

Location of Research

Location of research was deliberately selected at two locations having different characters of activity, namely (1) *subak* that has had socio-economic activity characterized by the establishment of farmer cooperative, and (2) *subak* that has not had socio-economic characterized by the non-establishment of farmer cooperative. It was assumed that both *subaks* would have different food security. On that account, one of them could be used as developmental model of food security based on *subak* indigenous wisdom.

Based on such criteria, Subak Lodtunduh at Singakerta Village, Gianyar was selected as *subak* that had farmer cooperative and Subak Anggabaya, at Penatih Village, Denpasar City as *subak* that has not had farmer cooperative yet.

Population and Respondent

Population is a group of individuals having quality and characteristic that has been stipulated. Meanwhile, respondent denotes a part of number and characteristic owned by population. Population in this research were all farmers becoming the member of Subak Lodtunduh amounting to 70 and all farmers becoming the member of Subak Anggabaya amounting to 162.

Furthermore, determination of 30 respondents was carried out randomly at each *subak*, with assumption that condition of all members of *subak* was relatively

homogenous in terms of social and economic status. The number as many as 30 respondents have been considered effective in the statistical analysis process (Champion, 1981).

Data

Data can be described into source of data and type of data. Data sources pose the data obtained right away from respondent (primary data) and data obtained indirectly, namely from related institution (secondary data). Primary data consist of identity of respondent and other information related to the objective of research. Meanwhile, secondary data comprise the characteristic of *subak* mentioned.

In the meantime, type of data is qualitative data consisting of descriptive information originated in several resources, and quantitative data are measurable data. Qualitative data may be in the form of information regarding to the role of farmer cooperative, and quantitative data are the ones related to agricultural production and so forth.

METHOD AND DATA ANALYSIS

Measuring the Index of Food Security

Food Security Index (IKP) is measured by method developed by The Indonesian Academy of Sciences or LIPI (2008). IKP was obtained by combining the four indicators of food security consisting of (1) adequacy of food stock; (2) stability of food stock without the existence of fluctuation from one season to another or through the years; (3) accessibility or affordability to food; and (4) quality or security of food. The four indicators were used to measure the food security at the level of household life at the area of research namely at Subak Lodtunduh and Subak Anggabaya. The measure of food security at household level was gradually calculated by combining the four food indicators to get food security index.

Later, it would be measured every indicator of food security as follows:

1. Adequacy of food will be seen in terms of food (rice) stock or availability in household. They consisted of (i) if rice is adequately available for 240 days or more, the food of household is considered adequate; (ii) if its availability between 1 to 239 days, it is considered less adequate, and (iii) if it has no rice stock, it is considered inadequate.
2. Stability of food stock was measured based on food adequacy combined with frequency of eating, whether farmer ate 3, 2 or 1 time a day.
3. Food accessibility was measured based on ownership of rice field land. If they had a land, its access was considered direct, while if farmers had no rice field were considered to have indirect access. By combining food, stability and food accessibility would be obtained food continuity.
4. Food quality was viewed in terms of its food type.

If the food consumed contained side dish having animal protein or animal protein and vegetable protein, its quality was good. If the side dish only contained vegetable protein was considered less good and if it did not contain both proteins was considered not good. Food Security Index (IKP) was obtained by combining food continuity and food quality.

Having obtained IKP of both *subaks*, it would be obtained the data which *subak* would have better IKP. Better IKP of *subak* will be used as food security model based on *subak* system.

Model of Food Security

Model of food security based on *subak* system will be described by relating various variables encountered. Expectedly, relatedness of such variables would describe abstraction of the existing reality at location of research.

RESULTS AND DISCUSSION

Index of Food Security

As has been proposed previously, there were four indicators used to measure food security at the level of household at location of research. The four indicators that would be discussed in the following session consist of (1) adequacy of food prosperity; (2) stability of food stock; (3) accessibility or affordability to food; and (4) quality or security of food.

(1) Adequacy of food stock

Food availability in household used in the measurement of food availability adequacy referred to sufficient food and they were available in an amount that could meet the need of household consumption. Determination of food availability period was viewed by considering the length of time between one planting season and next planting season (Suharjo et.al. in PPK-LIPI, 2008:1).

Stipulation on the research of PPK-LIPI in Lampung Province used Cutting Point 240 days as limit to determine if a household had sufficient or insufficient food stock. Determination of Cutting Point was based on paddy harvest that could be performed three times two years. This means the result of paddy harvest for three times (in two years) should be able to suffice the need of staple food of farmers within 730 days (two years). On that account, it was attained Cutting Point of 240 days (730 days are divided by the number of three times harvest in two years). This meant the availability of staple food (rice) should suffice the need of consumption for 240 days while waiting for the harvest of paddy in the following planting season.

Based on research at Subak Anggabaya and Subak Lodtunduh was known that all farmers committed rice harvest for two times within a year. It means that the result of rice harvest for two times (within a year) should be able to suffice the need of staple food of farmers for

365 days. For that purpose, in determining whether a household had sufficient or insufficient rice stock at these two *subaks*, it was used a *Cutting Point* of 180 days (365 days divided by the frequency of harvest within a year). In other words, the stock of staple food (unhusky rice) should suffice the need of household for 180 days until the following harvest.

Result of the research indicated, if observed per household of farmer, at Subak Anggabaya occurred 15 households (50 percent), adequacy of food (rice) availability exceeded the cutting point of 180 days and 15 other households (50 percent) had adequacy of food (rice) availability under cutting point of 180 days. At Subak Lodtunduh, laid 17 households (57 percent), adequacy of food (rice) availability exceeded the cutting point of 180 days, and 13 other households (43 percent) had adequacy of food (rice) availability under cutting point of 180 days (Table 1).

Table 1 Distribution of household based on adequacy of rice availability at Subak Anggabaya and Subak Lodtunduh, 2009

No	Adequacy of food (rice) availability	Subak Anggabaya		Subak Lodtunduh	
		HH Distribu-tion (PS I)	HH Distribu-tion (PS II)	HH Distribu-tion (PS I)	HH Distribu-tion (PS II)
1	≥ 180 days (Adequate category)	15 (50%)	14 (47%)	17 (57%)	17 (57%)
2	1-179 days (Less adequate category)	10 (33%)	11 (36%)	10 (33%)	10 (33%)
3	No stock (Inadequate category)	5 (17%)	5 (17%)	3 (10%)	3 (10%)

Remarks: HH = Household; PS = Planting Season

On the other hand, farmer household at both *subaks* underwent surplus of production if compared to their needs. This matter was proven by the amount of production sold was greater than the amount stored by farmer household.

The trend of farmers selling their rice (husky rice) crops produced was caused by access facility to purchase rice (unhusky) if farmers required. Other reasons were: (i) difficulty to get harvesting workers; (ii) considered to be more profitable by selling before harvest; and (iv) urgent need of money at the time of harvest.

Furthermore, it could be explained by means of average data that the research at Subak Anggabaya and Subak Lodtunduh indicated the adequacy of household food stock of farmer was greater than that on Cutting Point of 180 days. In other words, farmer households at both *subaks* had "adequate" food stock until the rice harvest in the following planting season.

(2) Stability of food stock

Stability of food stock is determined by adequacy of food stock and eating frequency of the household members in a day. Detailed result of the research indicated that at Subak Anggabaya there were 19 households (63 percent) having a habit of eating three times a day and 11 other households (37 percent) having

Table 2 Indicator of food stock stability at the level of household at Subak Anggabaya and Subak Lodtunduh in 2009

No	Food stock adequacy	Frequency of eating of household members in a day at Subak Anggabaya			Frequency of eating of household members in a day at Subak Anggabaya		
		≥3 times	≥2 times	≥1 time	≥3 times	≥2 times	≥1 time
1	≥ 180 days (Adequate category)	Stable 63%	Less stable 37%	-	Stable 100%	-	-
2	1-179 days (Less adequate category)	-	-	-	-	-	-
3	No stock (Inadequate category)	-	-	-	-	-	-

Table 3 Indicator of household food stock stability at Subak Anggabaya and Subak Lodtunduh in 2009

No	Food stock adequacy	Frequency of eating of household members in a day at Subak Anggabaya			Frequency of eating of household members in a day at Subak Lodtunduh		
		≥3 times	≥2 times	≥1 time	≥3 times	≥2 times	≥1 time
1	≥ 180 days (Adequate category)	-	Less stable	-	Stable	-	-
2	1-179 days (Less adequate category)	-	-	-	-	-	-
3	No stock (Inadequate category)	-	-	-	-	-	-

a habit of eating for two times a day. Meanwhile, at Subak Lodtunduh, 30 households (100 percent) had a habit of eating for three times a day. Afterward, detailed combination with the average of food (rice) stock adequacy will engender an indicator of food stock stability as presented in Table 2.

Information of respondents mentioned that the existence of frequency of eating for two times at household of Subak Anggabaya was merely caused by a habit, not denoting a strategy to suffice the food (rice) need to reach for the following harvest.

Later, by paying attention to the average data, the Subak Anggabaya resulted in an average frequency of eating at 2.63 times a day, while Subak Lodtunduh had average frequency of eating at 3 times a day. By combination of average food (rice) stock, adequacy and average of eating frequency would produce indicator of food stock stability at Subak Anggabaya and Subak Lodtunduh, as presented in Table 3.

From Table 3, it is discernible that combination of food stock adequacy at Subak Anggabaya with the average of household food availability ≥ 180 days and the average frequency of household eating habit at 2.63 times per day, made Subak Anggabaya into less stable category on the indicator of food stock stability at the household level. Meanwhile, that of Subak Lodtunduh was categorized into stable.

(3) Accessibility or affordability to food

Indicator of accessibility or affordability in food security measurement at the level of household was viewed from the easiness of household to obtain food, measured from the ownership of land and the way of household to obtain food. Status of land control or ownership at Subak Anggabaya was distributed as follows:

1. Farmers as owner-cultivator amounting to 13 persons (43 percent)
2. Farmers as owner and sharecropper amounting to 3 persons (10 percent)

3. Farmers as share-cropper amounting to 14 persons (47 percent)

Though farmers had status as sharecropper of the land, they were categorized into producing in person the food (rice) required. Therefore, without distinguishing the status of the origin of the land, whether the mentioned person owned or sharecropped the land, it could be categorized to have direct access. Similarly, farmer households at Subak Lodtunduh, though there was a farmer (3 percent) having the status as share-cropper, three farmers (10 percent) as owner & share-cropper, and most (87 percent) had the status as owner-cultivator, all were categorized to have direct access. Furthermore, indicator of food accessibility or affordability of farmer household at Subak Anggabaya and Subak Lodtunduh can be seen in Table 4.

Table 4 Indicator of food accessibility or affordability at the household level at Subak Anggabaya and Subak Lodtunduh in 2009

No.	Ownership of Rice Field Land	Way of household to obtain foodstuff	
		Self-production	Purchasing
1	Having the land	Direct Access	-
2	Not having the land	-	-

Based on Table 4, it could be known that all households at Subak Anggabaya and Subak Lodtunduh had the land and obtained foodstuff, self-production, so that indicator of food accessibility or affordability of farmer household was categorized to have direct access.

Furthermore, based on measurement of such accessibility indicator and then it was resumed by measuring the continuity of food availability denoting the combination of food stock stability and accessibility to food. This food continuity indicator reflected the households whether (1) they had adequate food stock; (2) consumption of household was normal; and (3) they had direct access to food.

Based on the measurement of food stock stability and accessibility to food, so the continuity of food

availability at Subak Anggabaya and Subak Lodtunduh can be described as presented in Table 5.

Table 5 indicated that combination of less stable food stock stability and access to food showing direct access made the indicator of food stock continuity at Subak Anggabaya less continuous, while Subak Lodtunduh indicated the continuous continuity of food stock.

Table 5 Indicator of food stock continuity on the household level at Subak Anggabaya and Subak Lodtunduh in 2009

Access to food	Food Stock Stability of Household at Subak Anggabaya			Food Stock Stability of Household at Subak Lodtunduh		
	Stable	Less stable	Unstable	Stable	Less stable	Unstable
Direct access	-	Less continuous	-	Continuous	-	-
Indirect access (purchasing)	-	-	-	-	-	-

(4) Quality or security of food

Food quality or security denoted the kind of food consumed to satisfy the nutritional need. Measurement of food quality or security was viewed from the existence or non-existence of animal protein and/or vegetable protein consumed in the households. Measurement of quality or security did not consider the kind of staple food.

Result of the research indicated that household of farmers at Subak Anggabaya and Subak Lodtunduh was accustomed to plant vegetables around their courtyard. Specifically at Subak Anggabaya, it has been suggested that every farmer household should have a pot to be planted with vegetables and spices. It meant to make it habit that they could live independently. Meanwhile, at Subak Lodtunduh, the farmers usually left few spaces of land to cultivate vegetables for their daily needs. During the crop season, farmers were more suggested to plant cereals.

In the implementation of ritual activities (Hindu ceremonies) in Bali, this endeavor also supported very much the supply of family nutrition. Oblations presented to God in all of His manifestations were always filled with fruits and meat. Having been offered, the fruit and meat could be consumed by family member. Meat presented consisted of pork, chicken and duck, including the egg of chicken and duck.

Based on the explanation, it could be concluded that farmer households at both *subaks* researched always consumed foodstuff containing animal protein, moreover the frequency of ritual organization in Bali was relatively high. In addition, in daily life the farmer household at both *subaks* consumed food that contained vegetable protein sourcing from cereals, tofu and fermented soybean cake. Consumption of other animal protein sourced from salt fish and fresh water fish. Vegetables they consumed ordinarily consisted of water spinach, spinach, cassava leaf, sweet potato leaf

and string bean. This meant that community of both *subaks* consumed foodstuff containing animal protein and vegetable protein in their daily life. On that account, farmer households at Subak Anggabaya and Lodtunduh could be categorized into the ones having good quality of food.

Index of Food Security

Stipulation of the food security was performed by combining the four indicators of food security, namely (i) food adequacy or stock; (ii) food stock stability; (iii) food accessibility or affordability; and (iv) food quality or security.

Combination between the food adequacy or stock and frequency of eating engendered an indicator of food stock stability. Later on, combination of food stock stability and food access produced an indicator of food stock continuity. Meanwhile, index of food security was measured based on combination of indicator of food stock continuity and food quality or security. Result of the research on the food security index at Subak Anggabaya and Subak Lodtunduh is presented on Table 6.

Data of Table 6 indicates that at Subak Anggabaya, combination of less continuous food stock continuity and food quality or security consisting of animal protein and vegetable protein, produced "less secured" food security index. Meanwhile, Subak Lodtunduh produced "secured" food security index, denoting a combination of continuous food stock continuity and food quality or security consisting of animal protein and vegetable protein.

Later on, to make the understanding easier on the measures of determination of food security index at Subak Anggabaya and Subak Lodtunduh can be described briefly as presented in Table 7.

If it was scrutinized, the measure determining the less secured food security index at Subak Anggabaya was the average eating habit that was less than three times a day. It was merely a habit and did not pose a strategy to suffice the foodstuff stock (rice) while waiting for the following harvest period.

Model of Food Security

Model is abstraction of several kinds of reality developing in the field. This means that, the making

Table 6 Index of food security at Subak Anggabaya and Subak Lodtunduh in 2009

Food Stock Continuity	Food quality or security at Subak Anggabaya			Food quality or security at Subak Lodtunduh		
	Animal protein and vegetable protein or animal protein only	Vegetable protein only	No Consumption of animal and vegetable protein	Animal protein and vegetable protein or animal protein only	Vegetable protein only	No Consumption of animal and vegetable protein
Continuous	-	-	-	-	-	-
Less Continuous	-	-	-	-	-	-
Not Continuous	-	-	-	-	-	-

Table 7 Determination measures of food security index at Subak Anggabaya and Subak Lodtunduh in 2009

No	Category	Subak Anggabaya	Subak Lodtunduh
1	Food Stock Adequacy*	≥ 180 days	≥ 180 days
2	Eating Frequency of Household Member	2.7 times per day	3 times per day
3	Food Stock Stability	Less stable	Stable
4	Food Accessibility or Affordability	Direct	Direct
5	Food Stock Continuity (combination 3 and 4)	Less continuous	Continuous
6	Food Quality or Security	Animal protein and vegetable protein	Animal protein and vegetable protein
7	Food Security Index (combination of 5 and 6)	Less Secured	Secured

Table 8 Variables of food security on subak system in Bali

No	Subsystem	Variable	Remarks
1	Thinking pattern	Performing activities of <i>subak</i> based on harmonic and togetherness concept	This matter is pursuant to the philosophy of <i>subak</i> , namely <i>Tri Hita Karana</i>
2	Social	Performing the regulation of <i>subak</i> (written and unwritten stipulations) properly	
		Developing socio-economic activities in <i>subak</i>	It can be in the form of farmer cooperative. It is in keeping with the formation of Village Credit Agency (LPD) at all customary villages in Bali
		Receiving assistance activities	Generally, it is undertaken in the circle of higher education in the implementation of social services to community.
		Performing mutual assistance activity Performing ritual activities	It is commonly carried out in maintaining or repairing irrigational networks, Subak Temple and collective ritual activities. Carried out at Subak Temple (Ulunswi, Bedugul Temple, etc.)
3	Artifact/Material	Performing the policy of mutual borrowing of irrigational water	This activity is performed by inter individual of farmer in the <i>subak</i> , inter group, inter <i>subak</i> or inter bending.
		Adopting innovation in the effort to improve the production of food plant	For instance, performing trial and error in the dissemination and implementation of various kinds of fertilizer, superior variety and other systems.
		Operating credit services to farmers	Farmers usually need credit on the land cultivation.
		Performing non-agricultural activities	Performed by farmers in their leisure time or beyond activities at rice field.

of model should be able to inventory various variables having significance in the process of model formation.

Actually, *subak* denotes a technology developing and synergizing with community culture. On that account, *subak* is known as an institution having socio-cultural characteristic. It was reflected by the activities of *subak* predominated by mutual assistance and ritual ceremonies. Therefore, the study on *subak* should be performed in the perspective of cultural system. Similarly, the study on *subak* that was conducted in relation to food security.

On assessing the *subak* in terms of cultural perspective as a system, it should be assessed in terms of three subsystems. They consist of thinking pattern, social and artifact or material subsystem. In the context of food security, variables forming the food security

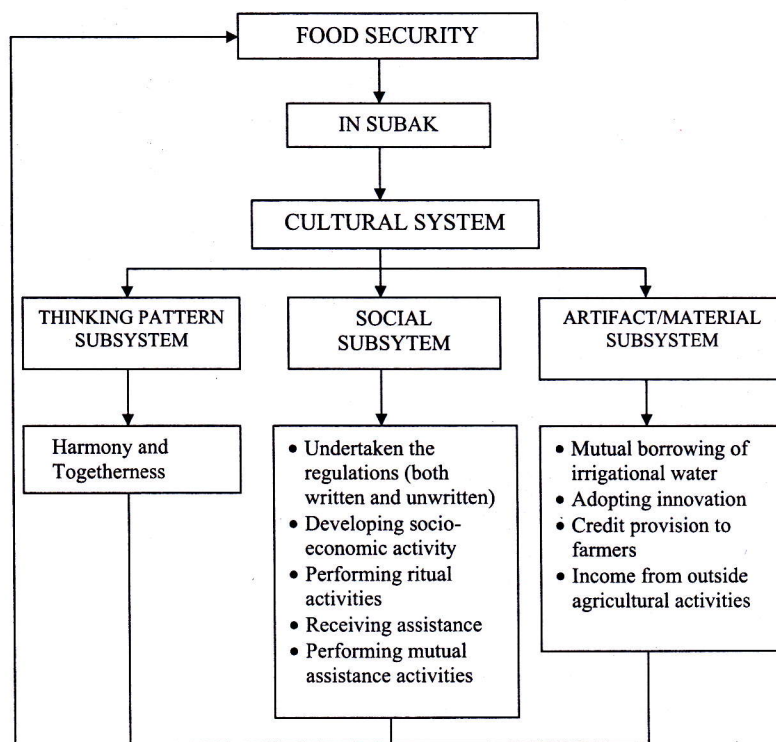


Figure 1 Food security model in Subak Lodtunduh, Gianyar in 2009

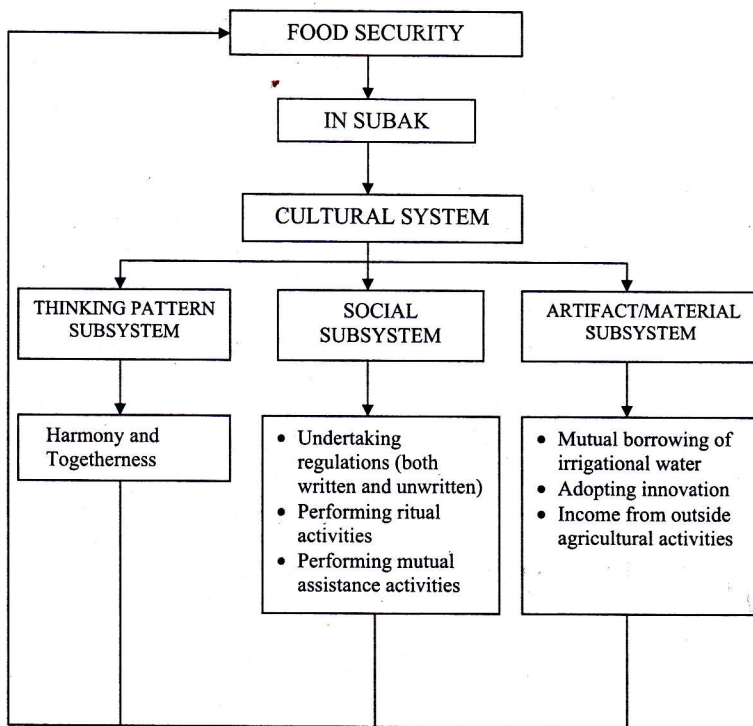


Figure 2 Food security model in Subak Anggabaya, Denpasar in 2009

can be formulated based on subsystems as mentioned above. Further details about variables on description of food on *subak* system can be described in Table 8.

Based on Table 8, it can be formulated that the food security model at Subak Lodtunduh and Subak Anggabaya as in Figure 1 and 2.

Based on Figure 1 and Figure 2, it could be understood that food security at Subak Lodtunduh was better than that in Subak Anggabaya. It was caused by Subak Lodtunduh has had economic activity (farmer cooperative) while Subak Anggabaya has not had this activity.

CLOSURE

Conclusions

Based on the previous descriptions, it can be concluded as follows:

1. Food Security Index at Subak Lodtunduh, Gianyar is categorized into "secure," while that of Subak Anggabaya, Denpasar is categorized into "less secure." This matter indicated that the food security index of farmer household at Subak Lodtunduh is better than that of Subak Anggabaya.
2. Research on the Food Security Model at both *subaks* was performed based on cultural system approach consisting of three subsystems, namely thinking pattern subsystem, social subsystem and artifact/material subsystem. All activities of subak were reflected in the three subsystems. Food security model at *subak* having economic activities in the form of farmer cooperative was better than in the *subak* that had no such an activity.

Policy Implications

Based on the findings in this research, it could be formulated policy implications as follows:

1. It needs an assistance process at Subak Anggabaya, so that farmer households at this subak could make it a habit to eat three times a day. By doing so, the status of its food security index would be getting better (from "less secured" to "secured").
2. Difference on the food security at Subak Lodtunduh from that at Subak Anggabaya was seemingly caused by the existence of economic activities in the form of farmer cooperative at Subak Lodtunduh. For that purpose, it is required further research to know if the existence of farmer cooperative at Subak Lodtunduh could improve its food security index.
3. It requires pilot project activity, namely by performing assistance for the formation of farmer cooperative at some *subaks* in Bali.

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