Sustainable principles of indigenous *chena* cultivation and management in Sri Lanka: lessons for contemporary agricultural problems

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Abstract: The central aim of this study was to identify lessons that can be learned from the indigenous *Chena* cultivation techniques to address the contemporary agricultural problems. Data for the study were drawn from a field survey conducted in a historically significant area for *Chena* cultivation—the *Kapugollawa* agrarian division in the *Rajarata* region of the country—during the period from May to August, 2014. By employing qualitative research approach, 40 experienced adult farmers, mostly over 70 years of age were interviewed. The findings revealed that sustainable principles and management practices of indigenous *Chena* cultivation in Sri Lanka provide solutions for contemporary agricultural problems such as issues related to agrochemical usage, high cost of production, insufficient income, issues related to cropland productivity, food safety and farmer safety, water shortage problem in farming, etc. Thus, study indicates the importance of taking into account sustainable characteristics of indigenous *Chena* cultivation technology to address contemporary agricultural problems.

Keywords: Indigenous *Chena* cultivation, Modern agricultural problems, Sri Lanka, Sustainable principles, Management practices

1. Introduction

Agricultural historians in Sri Lanka have focused little on the micro-level indigenous agricultural techniques and management practices that have been practiced and developed by indigenous farmers' overtime. It has been found that the indigenous agricultural structure in the dry zone of Sri Lanka is mainly based on a three-fold system, involving rice cultivation, shifting cultivation and home gardens. Shifting cultivation- mostly referred to as *Chena* cultivation-has been recognized as an important part of the rice-rice based subsistence agricultural economy of the country since ancient time. It is an agricultural system in which a selected plot of land is cultivated temporarily and then abandoned and allowed to return to its natural vegetation, while cultivation is shifted to another plot. This type of cultivation involves unique technology and management practices, which were developed based on the extensive experience of indigenous farmers over centuries.

The historical account of *Chena* cultivation system in Sri Lanka reveals a gradual decline of interest in *Chena* cultivation with the technological changes in agriculture and demographic changes in the country. First, the colonial empires neglected these systems because they were not suiting the needs of capitalist development as did plantation agriculture (cinnamon, tea, rubber and coconut) due to their subsistence nature. Therefore, the rules and regulations enacted by the colonial empires in the country set up barriers to *Chena* cultivation (Silva, 1981). For instance, underdeveloped land was defined by land ordinance No. 1840 (Crown Land Encroachment Ordinance) as all forest, waste, unoccupied or uncultivated lands, which shall be presumed to be the property of the crown until the contrary is proved. Under this land ordinance, the farmers in the dry zone first lost their land used for *Chena* cultivation because those lands were referred to as waste land. Most scholars criticize this land policy, as it did not correctly acknowledge the domestic traditions, customs and values attached to agriculture or the nature of domestic agriculture (Roberts, 1973). Second, the rapid increase of the population of the country limited the land suitable for *Chena* cultivation, and thus, farmers had to move to more marginalized agricultural land in the dry zone for *Chena* cultivation. Third, similar to other Third World countries, the application of universal social theory (technological changes in agriculture) to agriculture in Sri Lanka in the post-colonial period was the most influential cause of the major change in the techniques and management practices of *Chena* cultivation in the country. Similar to the rice sector, these technological changes were expected to enhance crop productivity in uplands and thereby ensure food security by taking into account economic models of agricultural production and technological change. These practices resulted in the difference between the techniques adopted in the past and present in *Chena* cultivation. The consequences of these technological changes have mainly been cited in the academic literature in terms of factors such as natural resource management, farm household food security, food safety, the regional environment and local resource utilization. For instance, the World Health Organization (WHO, 2012) reported a high rate of chronic kidney disease (CKD) among farmers who practice the modern *Chena* cultivation techniques. Some researchers have recognized the techniques adopted in *Chena* cultivation as rudimentary, which has led to misjudgement regarding the important values and principles of indigenous techniques of *Chena* cultivation from the view point of current problems accompanying modern techniques or Western scientific knowledge.

However, most researchers are interested in emphasizing the current limitations of *Chena* cultivation in terms of global climate change, population growth, resource use and management practices and biomass burning (Hettiarachchi, 1984; Sandika & Withana, 2010). It has been found that indigenous techniques used in agriculture are not practical for mass food production but can contribute a substantial amount to local food production in developing countries (Jeeva, et al., 2006). Though there are specific limitations of *Chena* cultivation, only a few researchers are doing relevant field work to identify the sustainable principles of indigenous *Chena* cultivation technology to understand to what extent these techniques provide solutions for the contemporary agricultural problems accompanying technological change in Sri Lanka. The identification and utilization of such sustainable principles of indigenous techniques in agriculture will help to fill the gap between indigenous and modern techniques in agriculture, which remains an important issue that should be focused upon. To fill this research gap in the field, the objective of this study is therefore to investigate the sustainable principles of the indigenous *Chena* cultivation system, with the aim of obtaining lessons related to contemporary agricultural problems in Sri Lanka and other tropical countries.

2. Materials and Methods

Historical-Comparative (H-C) methodology was employed in this study. Data for the study were drawn from a field survey conducted in a historically significant area for *Chena* cultivation—the *Kapugollawa* agrarian division in the *Rajarata* region of the country—during the period from May to August, 2018. This agrarian division was selected because the indigenous agrarian structure, particularly the indigenous *Chena* cultivation system, remains in the area. The reason for this situation is that the area is located far from the urban cities in the province and at the boundary of a conflict-affected area that has become peaceful since 2009. Thus, the influence of modern techniques in agriculture has not reached this area. According to the agrarian service center in the region, 600 ha were under *Chena* cultivation and 3,945 ha under paddy cultivation at the time of the survey.

Due to the nature of the phenomenon being investigated, the study mainly relied on qualitative data collected from farmers by applying the oral history method, which is a type of recollection method employed in historiography. For data collection, experienced adult farmers, mostly over 70 years of age, were selected for the survey, as these individuals represent the only remaining generation who still apply the techniques and management practices of indigenous *Chena* cultivation. In-depth interviews were conducted among 40 farmers selected by applying the purposive sampling technique. The survey gathered data on the details on farmers' past and present knowledge of the techniques and management practices applied in *Chena* cultivation in the region to reveal the importance of these techniques and to find solutions to contemporary problems in agriculture. Moreover, key informant interviews were conducted among the leaders and former leaders of traditional agricultural organizations and officers of the agrarian service centers in the survey area.

3. Results and discussion

3.1 Historical account of *Chena* cultivation in Sri Lanka

Chena cultivation has been practiced in Sri Lanka for thousands of years, similar to the countries of South Asia. There is much historical and archaeological evidence revealing the history of *Chena* cultivation. Archaeological excavations in the *Dorawaka-kanda* cave have provided evidence of the use of pottery and the cultivation of cereals as early as 6300 BC (Deraniyagala, 1992). The *Mahawansa* historical chronicle states that the *Yakka* Queen *Kuweni* weaved cotton (*Kapu*), indicating the existence of *Kapu Chena* in two thousand years ago. According to the historical literature, there were three types of cottage industries: weaving, producing jaggery, and extracting edible oil. This indicates the existence of formalized cotton (*kapu*), sugarcane (*uk*) and sesame (*tala*) cultivation in *Chena* lands. In particular, sesame, kodo millet *(Amu)* and meneri were grown by the people of the Anuradhapura period.

Moreover, the *Mahawansa*, *Thupawansa*, *Saddarmarathnawaliya* and *Pujawaliya* reveal that in the 13th century, crops such as kodo millet, meneri, finger millet, foxtail mille (*thanahal*), black lentil (*udu*) and green gram (*mun*) were grown by the local people. The *Saddarmarathnawaliya* further revealed that there were two cultivation seasons, *Yala* and *Maha*, and people reserved seeds for each season (*Govi Janatha, 2005*). Moreover, literature written in the Kurunegala, Gampola, Kotte and Seethawaka periods provides adequate evidence that *Chena* cultivation played a major role in the livelihood of local people. The inscriptions written by king Nissanka Malla (1187-1196) also referred to *Chena* cultivation. Specifically, Siriweera (2005) reported that there were many types of cereals grown in indigenous *Chena* cultivation, such as finger millet (*kurrakan*), *undu* (phaseolus mungo), *ma* (vigna cylidrica), *mun* (phaseolus aureus), *meneri* (Paspalum scrobiculatum), *aba* (Brassica juncea), *dura* (Cuminum cyminum) and *tana* (Setaria italic), in addition to vegetables such as *vambatu* (Solenum melongena), *vattaka* (squash Curcubita mixima) and *alu puhul* (waxgourd Benincasa hispida) and other Solenum species. The special interest of people in *Chena* cultivation in the indigenous period is further demonstrated by the names of ancient villages such as *Henegama, Weherahena, Viharahena, Ginigathhena, Henepola, Hendeniya, Kotahena, Nugahena* and *Mahena*.

3.2 Sustainable characteristics of indigenous techniques and management practices applied in *Chena* cultivation

3.2.1 Timely cultivation

In indigenous agriculture, timely cultivation indicates a specific set of cultivation practices adopted by farmers in each season, in line with the direction of the movement of sunrays towards the country—either from the Equator or from the Tropic of Cancer or Capricorn. According to the indigenous knowledge of the local farmers, the sunrays that fall on the Earth vary in each month, and these variations affect the life cycle of plants. Based on the changes in the sunrays reaching Sri Lanka, the indigenous farmers determined two cultivation seasons for the country: *Yala* and *Maha*, and they manage their cultivation practices accordingly. Table 1 provides the activities and stages of crop plant growth reported by the farmers in each month of the year for rice *Chena*. The scientific rationale for this technique was explained by the key informant interviews, as depicted in Figure 1. Based on this technique, the farmers traditionally cultivate short-term rice varieties, such as *Hetada vee*, for the *Yala* season and long-term rice varieties for the *Maha* season. This is mainly due to the short period of the shift in the direction of sunrays from the Equator to the Tropic of Cancer and from the Tropic of Cancer to the Equator and the long period from the Equator to the Tropic of Capricorn and from the Tropic of Capricorn to the Equator (Figure 1). In terms of other crops, the farmers take apply same technique, considering the life time of the crop species. In particular, there are specific months for harvesting each crop. For instance, in the *Maha* season, the farmers first cultivate four-month finger millet varieties in October. Harvesting generally begins in November, depending on the crops being grown, and may continue until January.

According to indigenous farmers' experience, the technique of timely cultivation first contributes to enhancing yields. The scientific rationale for this view is that in rice *Chena*, the panicle initiation time falls within the period of the lowest temperature difference between day and night, as the sunrays are directed toward the country from the Tropic of Cancer or Capricorn in the *Yala* and *Maha* seasons, respectively. Based on this technique, the farmers expect a high yield due to creating a favorable environment for pollination, particularly in terms of the temperature. Second, it reduces pest attacks and diseases, as the plant growing period falls within the period in which the temperature is relatively high, and the panicle initiation time falls within the relatively dry period. Third, it helps to manage the water supply throughout the plant growth period and harvesting time. As shown in Table 1, *Chena* practices are associated with the direction of the movement of sunrays and the rain calendar in the region, which will be discussed at length in the subsequent sections of the paper.

Table 1 *Chena* cultivation activities under timely cultivation techniques applied in rice *Chena* in the *Rajarata* region

Table 1: *Chena* cultivation activities under timely cultivation technique applied in rice *Chena* in the *Rajarata* region

Season	Month	Rice *Chena* practices and steps of plant growing period	Weather conditions
Yala season	April	Planting or sowing	Rainy period
	May	Plant growing period	Rainy period
	June	Panicle initiation time	Minimum temperature difference at day and night
	July	Maturing period	Dry period
	August	Harvesting	Dry period
	September	Land preparation	Dry period
Maha season	October	Planting or sowing	Rainy period
	November	Plant growing period	Rainy period
	December	Panicle initiation time	Minimum temperature difference at day and night

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	January	Maturing period	Lowest temperature and dry period
	February	Harvesting period	Dry period
	March	Land preparation	Dry period

Source: Field survey. 2018

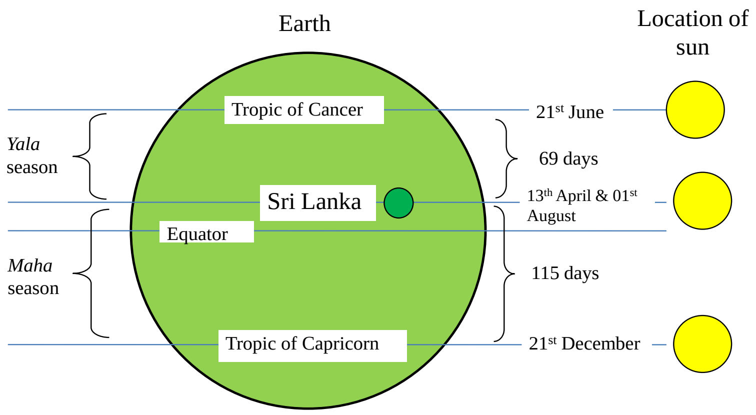

Figure 1 Scientific view of the timely cultivation technique

Source: Key informant interview with Mr. Thilak Kandegama, 2018

3.2.2 Rain calendar cultivation technique

In the *Maha* season, *Chena* farmers generally begin their land preparation activities when a light rain known as *Nikini paluwa* falls, which usually occurs from the end of July to early August, after the long drought known as the *Nikini* drought (*Nikini idoraya*, usually beginning in early July). First, the farmers cut the field to burn the existing biomass to recycle its nutrients. The sowing of finger millet takes place when the *Ak* rain falls, which usually occurs from end of September to early October. The aim of sowing finger millet with the *Ak* rain is to allow a harvest to take place in the face of the impending food shortage in farm households in December. Most of the *Chena* farmers in the region adopt the poly-culture cropping technique in association with the north-east monsoon rain (*Maha wesi*) (see Figure 2). One of the environmental indicators used to determine the end of the period for planting seeds is the blooming of *Niyagala* (Gloriosa superb) flowers in the region. The farmers assume that this indicator shows a relationship with rainfall patterns in the region and the direction of movement

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Table 2 Relationship of Chena Cultivation Techniques with Rainfall Patterns in the *Rajarata* Region

	Rainfall pattern	Period	*Chena* cultivation activities and steges of plant growing
Yala season	March (Slight rain) *Bakmaha wesi*		Commencement of land preparation for the *Yala* season
Maha	*Nikini* drought (*Nlikini*	July to the end of	

season	*idoraya*)	October	
	Nikini paluwa or *Wal ata wessa*—a slight rain	Approximately the end of July to early August	Commencement of primary land preparation
	Ak rain (*AK wessa*)—a slight rain	End of September to early October	Sowing the finger millet
	Transitional period (no rain)	Early October to mid-October	
	Northeast monsoon rain (*Maha wesi*)	Late October to late December	Sowing rice seed and adoption of poly-culture crop technique Harvesting of the finger millet
	Duruthu (low temperature or cool period)	January to February	Harvesting of finger millet and other crops
	February to March (dry period)		Harvesting the other crops

Source: Field survey, 2018

3.2.3 Lunar calendar farming technique in *Chena* cultivation

The indigenous *Chena* farmers strongly believe that the Moon affects the plant life cycle and therefore depend on the lunar calendar farming technique. In particular, decisions regarding periods for the sowing and harvesting of crops are made based on the lunar calendar. Table 7-3 shows how farmers determine the sowing and harvesting periods for different crops (seed and fruit crops, root crops and leafy vegetables). To explain the rationale for this technique, the farmers usually take into account several environmental indicators, such as the *wadadiya-badiya* scenario, the honey harvesting period and the assumed childbirth period. These indicators are tied to the idea that during the period of Moon movement from the new moon to the full moon, the water content in the human body as well as in crops gradually increases, and vice versa from the full moon to the new moon. This nature-bound law has been utilized by the farmers to classify indigenous crops grown under *Chena* cultivation to face challenges such as those related to water availability, pests and disease and to increase the harvest. For instance, the farmers consider the period of Moon movement from the new moon to the full moon as a suitable period for the sowing and harvesting of seed and fruit crops, as Moon affects the level of production. On the contrary, the farmers believe that the water content in the soil gradually improves in the period from the full moon to the new moon, and they therefore select this period for the growth of root crops, such as sweet potato, cassava and onion. However, they reported the period from the new moon to the first quarter and from the full moon to last quarter as particularly suitable periods for root crops. Based on the same principle, leafy vegetables grow from the new moon to the full moon period. This indicator basically affects the plant growth cycle and maturity at harvest, thereby increasing the harvest.

Table 3: Suggested periods for the sowing and harvesting of crops

Lunar cycle	Seeds & fruits (Cereals, pulses, oil seeds & fruits)	Roots	Leafy vegetables
New moon to 1st quarter (●→◐)	Rice, Finger millet, Sesame, Green gram, Cowpea, Black gram, Maize, Black lentil, Kodo millet, Mustard, Cumin, Foxtail mille, Horse gram, papaya, Banana, water melon	E.g., Sweet potato, Cassava, Onion	Pumpkin, Cucumber, *Tibbatu (Solanum indica, s.),* Egg Plant, Spine gourd, Bitter gourd, Ribbed gourd, Chili, Okra, Tomato, Long bean, Kakiri.
1st quarter to full moon (◐→○)			
Full moon to last quarter (○→◑)		E.g., Sweet potato, Manioc, Onion	
Last quarter to new moon (◑→●)			

Source: Field survey, 2018

3.2.4 Poly-culture cultivation technique and crop diversification practices in *Chena*

One of the main sustainable principles of the indigenous *Chena* cultivation technology is the use of diversified and poly-culture cropping techniques. These techniques are based on agro-ecological diversity and internal inputs at the regional and farm levels. This cropping structure is completely independent of chemical inputs and is integrated with locally and historically developed indigenous knowledge. Under the poly-culture technique employed in *Chena* cultivation, the farmers mix the selected types of seeds varieties together, and these mixed seeds varieties are planted under *Chena* cultivation. The farmers practice this technique to ensure the household food supply as well as nutritional balance and food security throughout the year and to minimize pests and control diseases in crop fields. According to the key informant interviews, the selected crop varieties for *Chena* have the special characteristic of attracting unfavorable pests to the *Chena* field at the first stage, which in turn attract favorable pests to the field. Thus, a natural environment is provided for controlling the pests on the crop without the use of any chemicals. In this context, the farmers specifically select nine types of crops for *Chena*, and it is therefore known as *Nawadalu Chena*. It was reported that the selected crop varieties also have specific characteristics related to controlling diseases and pests in the field. In addition to the poly-culture technique, the survey showed that the farmers practice crop diversification techniques by cultivating different types of crops at specific locations in the *Chena.*

Table 4: Number of crops grown in *Chena* cultivation: Indigenous vs. Modern

Indigenous *Chena*	Modern *Chena*
Rice, Finger millet (*Kurakkan*), Sesame *(Tala),* Green gram *(Mun),* Cowpea, Black gram (*Kalu kadala*), Maize *(Iringu)*, Black lentil *(Udu)*, Kodo millet *(Amu),* Mustard *(Aba),* Cumin *(Duru),* Foxtail mille *(Thana hal),* Horse gram *(Kollu),* Pumpkin, Cucumber, *Tibbatu (Solanum indica, s.),* Eggplant, Spine gourd, Bitter gourd, Ribbed gourd, Chili, Okra, Tomato, Long bean, Kakiri, Sweet potato, Cassava Papaya, Banana, Water Melon	Maize, Green gram, Cowpea Papaya, Banana,

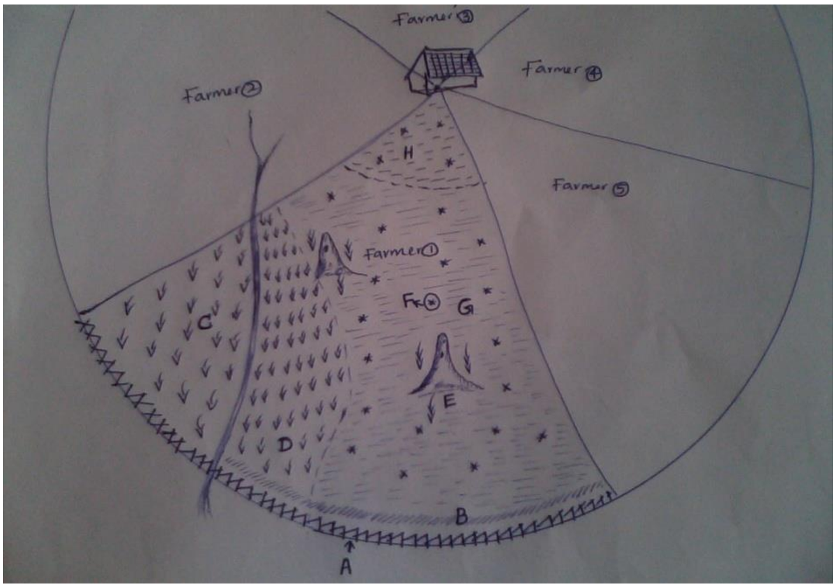
Source: Field Survey, 2018

Figure 2 Indigenous diversified and poly-culture techniques in the *Chena*

3.2.5 Land use and crop management techniques

One of the main arguments for neglecting the indigenous *Chena* cultivation technique is its low yields and, thus, lesser ability to support household food security. The analysis of our field survey data on the indigenous *Chena* cultivation system provides evidence against this argument.

The first step in land management practices is the assessment of land that is suitable for each crop. For example, in rice *Chena*, the farmers select the *kayan polowa*, where *kayan* trees grow. *Kayan* trees generally grow in lowlands where the water content and retention capacity are relatively high. Likewise, the identification of suitable land is basically carried out by the farmers using specific environmental indicators, such as specific trees, grasses or types of soil. Once land has been assessed, the farmer applies crop management techniques to achieve diverse objectives including pest and disease control, enhancing cropland productivity, securing the year-round household food consumption, optimizing rain water utilization and avoiding wild animal attacks. For instance, there are specific crops that grow close to fences, such as coriander (*koththamalli*) (see Figure 3—B). The reason for growing coriander is not only household consumption, but also to ward off wild pigs and other animals, as they strongly dislike eating coriander. Crops such as bitter gourd, chena gourd, sponge gourd, battle gourd and ash gourd are usually grown near the fence and later directed toward the fence (see Figure 3, ―A). As discussed in the previous section, poly-culture and diversified cropping structures are applied in the remainder of the land. Rice is grown in lowland areas of the *Chena*, where there is a relatively high water level in the land, mostly at the lower boundaryr of rain water channels (*Ara*) (see Figure 3, ―C). Finger millet, together with other specific crops, is generally grown at the upper boundary of the rain water channel (see Figure 3, ―D). The purpose of applying the poly-culture technique in finger millet cultivation is to provide an advantageous environment for finger millet, which is the main crop in the selected plot of land. The harvesting of the other crops in the finger millet plot does not take place at the same time but occurs much earlier than finger millet harvesting. Thus, the farmers must walk within the finger millet plot from time to time for harvesting, which helps finger millet to grow well. Okra, corn and green chili are grown around the *thumbasa* because of the good soil conditions for these crops (see Figure 3, ―E). Specifically, around corn plants, the farmers generally tend to grow long beans because corn plants become a support crop for long beans. Cassava, papaya and banana are grown in different areas of the *Chena* (see Figure 3, ―F). The harvesting period for cassava falls within the off-season, specifically in the dry period of the year, and this crop therefore becomes an important food for the farm household during the food shortage period. The rest of the area is used to grow many different types of crops, such as green gram, cowpea, black gram, maize, black lentil, kodo millet and water melon (see Figure 3, ―G). Yam varieties, some cereals, tomato, leafy vegetables and some other essential foods for the household are grown around the cottage in the Chena (see Figure 3, ―H). The purpose of growing these crops around the cottage is to protect them from animals such as monkeys and birds. These unique techniques of land and crop management applied in *Chena* cultivation enhance cropland productivity and thereby provide evidence countering the low yield argument. These techniques have diverse objectives, as described in this section, which are not practiced in modern agriculture.



A: Bitter gourd, Chena gourd, Sponge gourd, Bottle gourd, Ash Gourd	B: Coriander (*koththamalli*)	C: Rice	D: Finger millet, thiyabara, chili, aba, amu, meneri
E: Okra, corn, green chili	F: Manioc (cassava), papaya, banana	G: Green gram *(Mun),* Cowpea, Black gram (*Kalu kadala*), Maize (Iringu), Black lentil *(Udu),* Kodo millet *(Amu),* water melon	H: Yams varieties, some cereals, tomato, chili and some leafy vegetables.

Figure 7-3 Schematic representation of indigenous *Chena* ―*Mulkata Chena*

7.4 Concluding remarks: Lessons learned in relation to contemporary problems in modern agriculture

The purpose of this study was to identify lessons that can be learned from the indigenous *Chena* cultivation techniques to address contemporary agricultural problems.

First, as cited in the literature, environmental problems are the main concern of contemporary agricultural technology, due to the heavy usage of agrochemicals. In this context, our analysis of indigenous *Chena* cultivation techniques revealed that agriculture can be carried out without agrochemicals, with a proper understanding of the natural system. In particular, the direction of the movement of sunrays and the lunar calendar provide a great deal of evidence regarding the natural growth patterns of crop plants. These two nature-bound indicators correlate with the rainfall patterns in the region. The experience of the farmers has revealed the importance of these three factors for vigorous plant growth. It is assumed that if the timing of rice plant pollination falls around the 21st of December in the *Maha* season and the 21st of June in the *Yala* season, the yield will be increased by 16% from the average yield (Field interview with Thilak Kandegama, 2018). The adopted poly-culture cropping technique helps to minimize pests and control disease in the field, indicating that the farmers can use certain crop varieties to control pests and disease in the field. In particular, the farmers use indigenous seed varieties almost exclusively. These varieties are not responsive to modern agrochemicals and are highly resistant to pests and disease. Taken together, this indigenous knowledge demonstrates that agriculture can be carried out without polluting the environment.

Second, as cited in the literatures, modern agricultural technology has led to a high cost of production and therefore an insufficient net income for farmers to access the food market. In this context, the analysis of indigenous *Chena* cultivation provides two types of solutions: minimization of costs and maximization of cropland productivity. Specifically, nature-bound techniques, such as the application of timely cultivation and the lunar calendar and rain calendar, and the poly-culture cropping technique avoid agrochemical costs, which represent a large share of the cost of modern agriculture. On the other hand, the poly-culture and diversified cropping techniques enhance cropland productivity and support the production of the numerous food varieties required for household consumption throughout the year. This study demonstrated the fallacy of the low yield argument regarding indigenous agriculture, as the applied crop and land use management practices support high production by farmers, considering all of the crop varieties that are cultivated, at relatively low cost compared with the monoculture-based *Chena* system in the country.

Third, food safety and farmer safety are widely questioned under modern agricultural practices. This is one of typical concerns in Sri Lanka, as the WHO has found agrochemicals to be the major cause of an as yet unidentified kidney disease problem in the major agricultural regions of the country. In particular, the use of agrochemicals in modern *Chena* cultivation has been identified as the main cause of health issues among affected farmers. Thus, it is important to learn the special characteristics of indigenous *Chena* farming technology, as it has supported a healthy society for thousands years in Sri Lanka. As described above, the indigenous technology applied in *Chena* cultivation first avoids the usage of agrochemicals in agricultural land. Second, the technology supports to the production of many types of food by the farm household, due to the poly-culture cropping technique and diversification practices (see Table 4). Thus, these *Chena* techniques support a healthy and safe food consumption pattern among farm households, which clearly affects the household dietary intake, and there is therefore high support for securing household nutritional conditions and balance. These characteristics of indigenous techniques of *Chena* cultivation provide sustainable solutions for the contemporary health problems associated with modern technology because modern technology is biased towards several market-oriented crops, such as rice and maize. This is a very important finding of this study because, as cited in the literature, the change in food consumption patterns is the one of the reasons for the current health issues observed in the agrarian structures of Sri Lanka (Silva, 2014). Third, one of the main techniques adopted in indigenous *Chena* cultivation is the use of indigenous seeds for all crop varieties. The farmers traditionally maintain an indigenous seed bank within the household each year. In particular, it can reasonably be assumed that there is an association of the emerging health issues within the transformed agrarian structures, particularly in the survey district, with the change in seed varieties from indigenous varieties to high-yield varieties (HYVs) and the change in household dietary patterns, as indigenous varieties exhibit numerous medicinal properties, for example, in relation to cancer, diabetes and kidney problems.

Fourth, the application of the rain water utilization technique for crop plant growth provides another important solution to the contemporary water shortage problem in farming. Indigenous *Chena* is entirely dependent on rain. As described in the analysis, farmers traditionally know about the yearly rain calendar in the region. The pattern of crop planting is usually determined taking into account each step of the rainfall pattern and the length of the life cycle of each crop. For instance, finger millet is cultivated in association with *Ak* rain, but the cultivation of rice and other crops begins with the north-eastern monsoon. Moreover, the water utilization of each crop in the *Chena* is determined by assessing the suitable land for each crop by taking into account several environmental indicators, indicating that indigenous farmers apply a diversified water utilization technique to sustain *Chena* farming in each season. This situation is quite different from modern water management techniques because the modern technique of water management is unique to the region and all crop varieties and does not take into account the rainfall pattern in the region. Thus, this study indicates the importance of taking into account these characteristics of indigenous *Chena* cultivation technology to address contemporary agricultural problems. As there are some specific limitations in promoting *Chena* cultivation in Sri Lanka and the complexity of the current challenges regarding the food supply, researchers must at least, acknowledge these historically developed micro-technologies applied *Chena* cultivation to find an alternative solution for the contemporary problems in agriculture. Such an acknowledgement will help to enhance local food production in a safe and sustainable way.

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