



Contents lists available at ScienceDirect

Journal of Rural Studies

journal homepage: www.elsevier.com/locate/jrurstud

Indigenous knowledge of traditional foods and food literacy among youth: Insights from rural Nepal

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ARTICLE INFO

Keywords:

Food literacy
Agri-food knowledge
Gender
Community food security
High school students
Nepal

ABSTRACT

Food literacy among children and youth is configured by two knowledge domains: an *informal* community-based knowledge, and a *formal* curriculum-based knowledge. This paper examines how these two domains contribute to food literacy and strengthen food security among rural youth in Nepal. In consultation with schoolteachers and local farmers, a knowledge test was developed and administered to 226 high school students. Scores were collected on agro-ecological, cultivation and consumption-related knowledge on a locally grown staple crop, as contributor to food literacy. Sociocultural factors like age, gender, level of education, migration of household members, level of student interest, and spatial factor like location of school all have an influence on food literacy. While formal school-based education and community-based informal knowledge oppositely interact, there is space for these two domains to synergistically interact to enhance food literacy. Rural students have potential to enhance food literacy in the schools, provided the schools create supportive space for experiential learning that weaves community-based Indigenous knowledges of local foods. However, an effective promotion of food literacy can only be ensured by adopting a holistic approach that includes a wide range of actors such as students, parents, teachers, schools, community organizations and government institutions.

1. Introduction

Food literacy is gaining increasing attention in contemporary society as food becomes recognized as more than just a source of caloric requirements for the human body: it carries important information for people's health, nutrition, culture and tradition. Although the concept of literacy takes many forms, such as functional, computer or ecological literacy, until now it has not included the growing and interconnected set of issues that focus on food (Summer, 2013). Today, people strive to understand the technical, cultural and ethical aspects of the foods they eat, and the notion of 'literacy' has broadened from gaining competence on specific subject matter to improving understanding on everyday activities, including eating. Therefore, a new form of literacy – food literacy – is needed to help us analyse and address these complex issues. Food literacy is being informed about what to eat for better health, how to access to nutritious food, and having the ability and motivation to

apply that knowledge (Block et al., 2011). In other words, food literacy consists of the knowledge associated with food, including agro-ecological knowledge (where and what type of food is produced), cultivation and production knowledge (how food is produced), and processing and consumption knowledge (how food is prepared and distributed). The knowledge in each of these categories or spheres can be derived informally from people's everyday practices in home and community environments, or gained formally from structured curriculum-based learning typical of school environments (Reyes-García et al., 2010).

Food literacy holds great significance for a landlocked country like Nepal, where food security implies a self-reliance on food production at community and national levels, thereby creating resilience among its citizens against any natural disasters or political problems that the country occasionally experiences. The government's limited capacity to tackle large-scale natural disasters such as the 2015 earthquake shows the importance of food self-sufficiency in recovering from such a shock.

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The 2015–2016 crises¹ on Nepal's southern border also illustrate the country's vulnerability to food insecurity, which has developed through importing food and agricultural inputs from foreign markets.

Literature shows a strong connection between food literacy and food consumption, especially with respect to hygiene and nutrition awareness (Cullen et al., 2015; Kimura, 2011; Vidgen and Gallegos, 2011). There is also an extensive literature available on food security and food consumption (Deaton and Drèze, 2009; FAO, 2013; Maxwell and Smith, 1992; Patel et al., 2015; Patel, 2009). In studies of remote rural and Indigenous communities, scholars have identified strong relationship between Indigenous knowledge systems and food security (Kamwendo and Kamwendo, 2014; Lunga and Musarurwa, 2016; Oniang'o et al., 2004). Shahvali (2011) argues that Indigenous knowledge is an essential component for local development and suggests that it can help eradicate poverty by enabling local people to access more of the resources required for survival. Some scholars have also demonstrated how Indigenous food knowledge can be an important constituent of community empowerment through active involvement of rural and tribal male and female youth – who are vital to promoting and conserving Indigenous knowledge and ensuring a community's future food security associated with food production and consumption (Davis and Wagner, 2003; Shukla et al., 2017). However, the relationship between food security and food literacy – more specifically, how Indigenous food knowledge contributes to food literacy and ultimately strengthens food security among youth – is a less studied aspect in this scholarship.

Drawing upon the experience of high school students from rural Nepal, this paper illustrates how the informal (local or community-based) knowledge domain shapes food literacy in rural and predominantly Indigenous communities. We demonstrate how such informal knowledge-based food literacy is shaped by personal and social-economic factors such as age, gender, caste/ethnicity, and location of schools, and performance in formal (curriculum-based) education at school. We illustrate how rural students could contribute to food literacy through experiential learning initiative supported by the schools and how schools can create space and opportunity for informal food literacy to help develop a full food literacy that will strengthen community food security.

Our research focuses on high school students, because they experience the interface between formal knowledge at school and informal knowledge at home with respect to their own food and nutrition are self-motivated to learn from both knowledge systems. A food literacy that is predominantly shaped by informal food knowledge in such communities can, when placed alongside formal schooling, enhance the overall food literacy and community food security of current and future generations.

In the following section, we provide an overview of the literature on food literacy, including informal food literacy shaped by Indigenous knowledge and its relationship to food security. This section also describes the concepts used in the paper and outlines the framework on which our research is based. Methods of data collection, the communities studied, measurements of informal food literacy obtained through a traditional food knowledge test and analysis of data are presented in the methodology section. The analysis and findings, including results of the knowledge test and comparisons with academic performance and selected social-economic variables, are reported next. Finally, we discuss the importance of food literacy and how it is intertwined with both

¹ A political misunderstanding led to an undeclared (unsanctioned?) economic blockade of the border between India and Nepal in late 2015. For more than four months, food and non-food items, including petroleum products, were not allowed into Nepal, affecting people from all walks of life. One national newspaper warned, 'The school cannot provide snacks to your children due to acute shortage of cooking gas, please do send your children with the required snacks' *The Rising Nepal*, 2015. Blockade's effect on children. *The Rising Nepal*, Kathmandu.

formal and informal knowledge domains. We conclude by highlighting the roles different stakeholders play in promoting food literacy in order to strengthen food security at household and community levels.

2. Literature review and conceptual framework

2.1. Food literacy in the food security literature

Probably because in most developing economies, food security is still a matter of physical availability of and economic access to food, literature on how food literacy contributes to food security or how food literacy is important for food security is rare. There is a strong relationship between food security and food literacy (Gallegos, 2014; Palumbo, 2016). Begley et al. (2019) observed their food insecure research participants 1.4 times less likely to use nutrition information panel for food choices and use other parts of food label when buying food, indicating a strong relationship between food security and food literacy.

However, classical approaches to food security have paid little attention to food literacy, as 'food' is normally considered simply a substance to eat to fulfil the human body's caloric requirements. The indicators of food security used by major international development agencies such as The World Bank, Food and Agriculture Organization (FAO), World Food Programme of the United Nations and others emphasize food availability and insufficiency among poor people. The FAO food security report, a yearly publication on the status of food (in)security in the world, has overlooked the significance of food literacy, including in its most recent report (FAO, 2018). The 2013 comprehensive report (FAO, 2013), covering multiple dimensions of food insecurity including availability, access, utilization and stability, also does not explain the importance of food literacy.

The role of social values and cultural interpretations cannot be ignored in developing an understanding of people's preference for specific foods, particularly traditional foods or country foods. For example, many rural, remote and Indigenous communities in South Asia often know the nutritional and medicinal values of foods prepared from traditional crops, but because of social taboos, they refrain from eating such foods that have lesser social value (Gartaula et al., 2012). This is a fitting example of food literacy that helps illustrate various aspects of food security, including production, processing and consumption. This is because although food decisions are made individually, the choices are influenced by internal and external factors (Cullen et al., 2015). In this regard, the World Development Report 2015 identified three principles of human decision-making adopted from development policy: thinking automatically, thinking socially, and thinking with mental models. 'People are malleable and emotional actors whose decision making is influenced by contextual cues, local social networks and social norms, and shared mental models' (World Bank, 2015: 5). The 2015 World Development Report does not explicitly mention food literacy, but the rationale of human decision-making implies the concept of food literacy, as it indicates human cognition.

2.2. Formal and informal knowledge domains in food literacy

Food literacy entails understanding nutritional information and acting on that knowledge in ways consistent with promoting nutritional goals and food well-being. It is categorized into (a) *conceptual* or *declarative* knowledge (reading and acquiring knowledge about food); (b) *procedural* knowledge (knowledge on how to get food, how to prepare food, etc.); and (c) the ability, opportunity and motivation to apply or use that knowledge (Block et al., 2011). In other words, food literacy is literacy around what to eat for good health and how to access nutritious food and having the ability and motivation to apply this knowledge. One of the pioneering studies of food literacy defines the term as the relative ability to understand the nature of food and its importance to someone, and how one gains information about food, processes it,

analyses it and acts upon it (Vidgen and Gallegos, 2011). The concept of food literacy has evolved from earlier notions of knowledge around nutrition, health and physical well-being to a broader understanding of the food system that includes social, economic, cultural, environmental and technical factors as important parameters of food literacy (Cullen et al., 2015; Sumner, 2013). In this sense, food literacy can also be viewed as ‘cultural literacy’, drawing upon food preparation, food skills, nutrition knowledge and involvement in cooking as components of cultural literacy (Snyder, 2009). Most recently, food literacy scholars have considered the meaning of the term as learning (food skills, knowledge and behaviours) from everyday dietary practicalities that will lead to healthy living (Vidgen and Gallegos, 2014).

From the perspective of formally trained food practitioners, such food literacy is shaped by how everyday food practices meet the country's nutritional guidelines. Recognizing the importance of formal education on the food literacy of high school students, the majority of participants in one study felt that food literacy should be a compulsory subject for senior secondary school students (Nanayakkara et al., 2018). Other study participants indicated that formal literacy education helps students establish healthier eating patterns, join food-related career pathways, and understand and question the food system and related issues (Nanayakkara et al., 2017). They argue that education authorities should seek ways to include multiple stakeholders in the design and delivery of food literacy education.

Some scholars include food literacy under the umbrella of agricultural extension education system and show opportunities for schools and universities to integrate contents of science, social studies, and health aspects of agricultural commodities (Spielmaker and Leising, 2013). Nepal has a different story in this respect. For example, in an overview of literature, Uprety and Shivakoti (2019) illustrate that Nepal's agricultural extension system is undergoing changes since its institutional start in the 1920s, with no focus on food literacy and without much room for integrating local and Indigenous knowledge systems. Their review does not provide any evidence or indication on education oriented (targeting or engaging schools) or food literacy promoted models in the mainstream agricultural extension models in Nepal. The purpose of agricultural extension has been changing from production oriented government operated extension services to the current demand driven private sector involved delivery models. Some outreach approaches like farmers field school, farmer group, local service provision, etc. have been tried in Nepalese agricultural extension system (Basnyat, 1995; Westendorp, 2012). However, in the mind-set of ‘top down expert model’ of agricultural extension (Ghimire et al., 2014), there seems to be less room for integrating local and Indigenous knowledge systems. In our study communities, as reflected in the mainstream extension system, there is no specific curriculum content, field courses or extracurricular activities to help students understand any aspects of Indigenous foods, such as millet-based foods. An examination of the curricula of participating schools in our study communities showed that there were no agriculture or Indigenous food courses (covering nutritional value, production, preparation, processing, etc.) available for students. Food-related knowledge mostly came from community sources through informal learning.

Parallel to food literacy studies, another set of literature shows that both formal and informal knowledge related to food is important to food security in both Indigenous and non-Indigenous societies (Bellotti, 2010; Setalaphruk and Price, 2007). In many rural, remote and farming communities, including our study communities in Nepal, where small millets are still an important part of local food culture, the knowledge, practices and belief systems around small millets constitute a significant component of informal food literacy relevant to the current and future health of the communities.

This informal knowledge is considered Indigenous knowledge in the sense that it is unique to a specific cultural context and transmitted through the household socialization process, requiring considerable interaction among household members (Jonjoubsong and

Chinnakunwong, 2010; Setalaphruk and Price, 2007). It is a systematic body of knowledge acquired by people through an accumulation of their experiences through informal experiments, coupled with an intimate understanding of the local culture (Warren and Rajasekaran, 1993). This corresponds to the understanding that Indigenous knowledge is gendered, as men and women have specialized knowledge about farming, healing and resource management that is linked to culturally constructed gender roles and relations (Christie et al., 2016; Harman Parks et al., 2015; Lambrou and Laub, 2006; Wayland, 2001). Even though, women's (agricultural) knowledge and skills are under-valued mainly due to the gender stereotyped social structure that sees farming women as farmwives or labourers, not necessarily farmers or agricultural decision makers in South Asia (Gartaula et al., 2010; Trauger et al., 2008).

We consider formal knowledge to be knowledge that students acquire in classroom settings using formal syllabi, while informal knowledge is knowledge they learn in home and community environments, using informal networks of kinship and social relations. Drawing upon Agrawal (1995), we argue that formal school-based knowledge and informal community-based Indigenous knowledge are two domains that intersect in students' knowledge systems as they learn about food, agriculture and environment at school and at home, which can shape food literacy, or food *bildung* (Benn and Carlsson, 2014), of youth who will be instrumental in feeding the future. In this viewpoint, Vesterinen et al. (2016) argue that to make formal education gamechanger for sustainable citizenship science, mere understanding of social and scientific issues is not enough; students should get opportunities to take actions. Considering students future decision makers, the role of formal education is crucial to provide experiential learning based activities that help students become effective, life-long learners in *agricultural and food related knowledge* (Rudebjer et al., 2011, *emphasis added*), and help develop socially responsible science education (Cross and Price, 1991).

Empirical research on the role of food literacy to conserve Indigenous knowledge and improve food security is rare. In particular, the role of community-based contextual and informal learning and social networks in shaping the food literacy in rural farming communities remains a neglected area of research. Likewise, revitalization of Indigenous food systems, including traditional crops such as millets and associated knowledges are gaining attention of policymakers and practitioners (Khunlein et al., 2009). These traditional food crops are also known as orphan crops (Bharucha and Pretty, 2010). Such a need is also echoed by food literacy scholars like Smith (2009), who acknowledge that food-literate students embrace other ways of knowing (informal learning in families/homes) alongside formal scientific knowledge.

Thus, in the communities we study, we underscore the importance of traditional crops such as millets and associated food knowledge in shaping food literacy among young people in rural Nepal.

3. Research methodology

This research was part of a large interdisciplinary project on promoting food and nutrition security through small millets, conducted by a consortium that included partners from academic and research institutions in South Asia and Canada. In Nepal, the field research was coordinated by an NGO called Local Initiatives for Biodiversity, Research and Development (LI-BIRD). Following an explanatory sequential mixed-methods research design (Creswell, 2015), several field visits were made to rural Nepal between 2012 and 2016. During those visits, we had a series of conversations with farmers on matters relating to small-scale agriculture, technological change, sustainability of family farms, Indigenous knowledge and other issues. A common concern across the region, regardless of topography, ethnicity and cultural differences, was that the younger generation is not interested in agriculture. These farming communities were concerned about the future of their livelihood practices, the Indigenous knowledge that had been



Fig. 1. Map of Nepal showing the research areas in Kaski district.

passed down from their ancestors for generations and the food habits of their children: What were they going to eat if they did not grow or learn about food? These conversations highlighted the importance of food literacy and the sustainability of small family farms in Nepal.

These conversations evolved into a systematic research inquiry on the knowledge and interests of youth with respect to food and agriculture. We devised a knowledge test for high school students in the research area, which was conducted in the six schools located around Pokhara valley, in the Province 5 (Fig. 1). The school selection was made by LI-BIRD, the local partner, based on relevance of the topic to the research communities and on the school's inclusion in the larger project. All the selected schools were high schools, and students from grades 9 through 12 participated in the knowledge test. Academic records of participating students were also collected.

Located about 200 km west of the capital city of Kathmandu, Kaski district has a per capita income of \$1561 per year, which is slightly higher than the national average of \$1160 (UNDP, 2014). Covering about 2000 square kilometres, Kaski has a total population of about 500 thousand (52% women) living in 125 thousand households (CBS, 2011). The elevation of Kaski district ranges between 450 and 8091 m above sea level (Annapurna Massif), resulting in a considerable diversity of topography, climate and vegetation across the slope and a scenic beauty promoted by the country's tourism industry. Pokhara city is endowed with abundant ecological richness and agricultural potential around the valley. The lower elevation has a warm, humid and subtropical climate, while the mid-elevation harbours a cold, dry and temperate climate. This results into two distinct cropping patterns: a rice-based pattern in the warmer lowland riverbank areas, and a maize/millet-based pattern in the colder upland areas. The higher elevation (over 5000 m above sea level) is mainly mountainous, famous for trekking, hiking and related tourist activities. Agriculture is largely subsistence oriented and is practised by small and marginal farmers.²

3.1. Collecting and measuring informal knowledge

Measures of informal knowledge were collected by means of a knowledge test on the most commonly used traditional food crop, finger millet, conducted among 226 high school students from both rural and urban areas in Kaski district. The methodology for the knowledge test was adopted from Chand and Shukla (2003), who conducted biodiversity contests to uncover children's knowledge about medicinal plants. The method was first discussed with farmers around the schools, most of whom were parents of the students who participated in the test. We discussed key knowledge related to cultivation practices and the processing of finger millet.

The test questions were developed in consultation with local community researchers who had been working with the local farmers. The test questions were pilot-tested on 11 students from other schools outside the study area and adjusted to align with the research objectives and reliability of the answers.

Based on our discussions with farmers, a knowledge test on finger millet was designed and administered at the schools. For each school, we organized a meeting with the school headmaster and grades 9 to 12 teachers about two weeks prior to the test date. A written request for participation was handed over to the school management during the meeting, and a consent letter was signed by the researcher and the school principal. Following that, the teachers of the respective grades

² The Central Bureau of Statistics classifies farmers across the country based on their landholding size. The classification is different in the *terai*, mid-hill and high-mountain regions. In the absence of other regional classifications, we have adopted the classification for mid-hills, since Dhikurpokhari is located in mid-hill region. According to this, households having fewer than 1.25 acres of land are categorized as small; those with 1.26–4.9 acres as medium; and those with 5.0 or more acres are categorized as large farmers CBS, 2013. National Sample Census of Agriculture Nepal, 2011/12. Central Bureau of Statistics, National Planning Commission, Government of Nepal.

Table 1
Evaluation of students' informal knowledge domain on finger millet-based food literacy.

Knowledge category	Weighting	Items included in the test
<i>Knowledge acquisition</i>		
Agro-ecological	0–1 pt	What type of land is most suitable for finger millet?
	0–3 pts	Name up to three varieties of finger millet.
	0–3 pts	Name up to three weeds of finger millet.
Cultivation/agronomic	0–3 pts	Name up to three insects/diseases of finger millet.
	0–1 pt	Do you know how to plough?
	0–2 pt	How many times do you do weeding for finger millet?
	0–1 pt	What is the best month to harvest finger millet?
Consumption/processing	0–1 pt	What is the most common method for threshing finger millet?
	0–1 pt	Name the main home-made foods from finger millet.
	0–3 pts	Name up to three medicinal uses of finger millet.
	0–3 pts	Name up to three nutritional uses of finger millet.
	0–3 pts	Mention up to three cultural values of finger millet.

notified their students about the test. Participation in the test was entirely voluntary and prizes were announced to provide incentive to participate. After evaluating the test, the top male and female scorers each received a prize.

In the test, knowledge acquisition questions were grouped into three categories: agro-ecological (understanding ecological aspects such as the crops grown in the area, varieties of finger millet, and insects, pests, weeds affecting finger millet crops); cultivation or agronomic (different stages of cultivating finger millet such as ploughing, weeding, harvesting and threshing); and consumption and processing (knowledge about the products of finger millet grains, and understanding of medicinal, nutritional and cultural value of finger millet food). The scores achieved by students in these three knowledge spheres are called ‘food literacy scores’ in this paper (see Table 1).

Each correct answer was weighted based on its difficulty and used to calculate the food literacy scores of individual students. For example, the correct answer to a common-knowledge question, such as main product of finger millet, would score 1 point, while a correct response to a slightly more difficult question, such as insect pests, would get 2 points. All answers in each category were then totalled as the score in that particular category.

3.2. Collecting and measuring formal knowledge

We collected information on formal knowledge, in the form of academic scores for each student, the same students who participated in the knowledge test that assessed their informal knowledge. We compiled exam records at their respective schools and collected their total scores from final exams of the preceding academic year.

As mentioned earlier, we searched for agriculture-related subjects in the schools and confirmed there were no courses that would impart agricultural and Indigenous food-related knowledges. Thus, we could not actually measure the students' food literacy as imparted through the formal knowledge domain. However, we assumed that each student's academic record would demonstrate his or her overall competency and learning capacity. Simply put, the reason to collect school records of participants was to consider their test scores in the informal knowledge domain in the context of their academic performance, rather than to compare the food literacy they gained informally with that acquired through formal sources.

3.3. Data analysis

The quantitative data described above were supplemented with qualitative data gathered from five group interviews with farmers and four focus group discussions with schoolteachers and participant students. The qualitative data were analysed through qualitative content analysis, which allows researchers to understand social reality in a subjective but scientific manner by examining the meanings, themes

and patterns that manifest in particular texts (Zhang and Wildemuth, 2009). Excel and SPSS 24 were used to draw descriptive statistics, correlation and ANOVA from the codified quantitative dataset.

4. Results

4.1. Profile of students and the knowledge test

Majority of the students who participated in the informal knowledge food literacy test were boys in their early to late teens (average age of 16 years), studying in grades 9 through 12. More than half belonged to Brahmin-Chhetri caste/ethnic groups, with the remainder belonging to Janajati and Dalit groups. The students' ethnic distribution follows a similar trend to that of the district population, which is 45% Brahmin-Chhetri, 33% Janajati and 16% Dalit groups (DDC Kaski, 2013).

More than two-thirds of the students belonged to families where one or more members had migrated outside of the household for work. A significant number of students (71%) had one parent who was a migrant worker. A distribution of students by age, school grade, gender, ethnicity, migration status, and location of schools is shown in Table 2.

All student participants attempted to answer all the questions that tested their informal knowledge acquisition related to agro-ecological, cultivation and consumption spheres, making the response rate 100%. Of the total responses, 88% of the students scored over 78%. Of the 20 questions asked to assess small millets-based food literacy, seven

Table 2
Profile of student participants (N = 226).

Particulars	N	%
<i>Age (mean 15.8, min. 13, max. 21, SD 1.5)</i>		
14–15 years	126	55.8
16–17 years	86	38.1
18–20 years	14	6.2
<i>Grades</i>		
Grade 9	131	58.0
Grade 10	47	22.8
Grade 11	26	11.5
Grade 12	22	9.7
<i>Caste/ethnicity</i>		
Brahmin-Chhetri	133	58.8
Janajati	57	25.2
Dalit	36	15.9
<i>Gender</i>		
Male	119	52.7
Female	107	47.3
<i>Migration status of household members</i>		
Migrant	155	68.6
Non-migrant	71	31.4
<i>Location of school</i>		
Rural	95	42.0
Urban	131	58.0

Table 3
Knowledge acquisition among high school students in the research area.

Student categories	N	Informal knowledge (%)				Formal knowledge (%)
		Agro-ecological	Cultivation	Consumption	Overall informal	
<i>Age</i>						
14–15 years	126	38.2 ^a	51.7 ^{ab}	57.8 ^{ab}	58.1 ^{abc}	70.4 ^{ab}
16–17 years	86	74.6 ^a	62.0 ^a	70.8 ^a	53.4 ^{ab}	55.4 ^a
18–20 years	14	82.9 ^a	72.4 ^b	77.7 ^b	54.1 ^{ac}	50.6 ^b
<i>Caste/ethnicity</i>						
Brahmin-Chhetri	133	62.7 ^a	59.6 ^a	67.2 ^a	63.2 ^a	64.3 ^a
Janajati	57	25.8 ^{ab}	49.2 ^{ab}	51.9 ^{ab}	42.3 ^{ab}	69.3 ^a
Dalit	36	71.9 ^b	58.9 ^b	71.2 ^b	67.3 ^b	51.7 ^a
<i>Migration</i>						
Migrant	155	57.8 ^a	57.1	63.7	76.9	61.2 ^a
Non-migrant	71	48.4 ^a	56.4	63.6	79.5	67.7 ^a
<i>Gender</i>						
Male	119	46.5 ^a	55.7	56.9 ^a	76.5	67.1 ^a
Female	107	64.2 ^a	58.2	71.8 ^a	78.2	59.7 ^a
<i>Location</i>						
Rural	95	87.0 ^a	66.4 ^a	79.3 ^a	77.5 ^a	52.6 ^a
Urban	131	31.5 ^a	50.0 ^a	52.9 ^a	44.9 ^a	71.6 ^a

^{a,b,c} indicate that statistical means with the same letter in the same column are significantly different at 0.01 level (one-way ANOVA).

For Gender and Migration categories, an Independent-Sample T-Test was performed.

questions received 80–100% correct answers, while five questions received 50–79% correct answers and the remaining eight questions received less than 79% correct answers. At the same time, the exam records (formal knowledge) of the preceding school year showed over two-third students scored above 60%, which is the official score to mark first division (equivalent to A) in their certificate. This means most of the students were found to be generally knowledgeable in both formal and informal knowledge domains.

4.2. Local contextual factors affecting the informal domain of food literacy

The average student score on all three knowledge spheres – agro-ecological, cultivation, and consumption – was 59%, representing a high level of informal food literacy. Caste/ethnicity, migration (of one household member), age and gender appeared to be the important factors impacting the acquisition of informal knowledge in the research area.

Of the caste groups, the Janajati demonstrated less knowledge than the Brahmin-Chhetri and Dalit groups did in all informal knowledge spheres but outperformed other caste groups in acquiring formal knowledge. The Janajati people in this area are known for their physical endurance in adverse environments and for their combat skills. Many Janajati students in our sample came from households where at least one male member, either the father or elder brother, was employed in the Gurkha Regiments in India, Singapore or the United Kingdom. Other family members in Janajati households who reside in the village generally do not cultivate their lands. They rent out for sharecropping, which provides children less opportunity or impetus to learn about agriculture. However, within the spheres of informal knowledge, the Janajati students were found to score higher on knowledge related to consumption than on agro-ecological and cultivation knowledge. It is evident from our conversations with local people that even if the Janajatis are not extensively involved in cultivation, their cultural activities and food habits require the use of finger millet for preparing *rakshi* (local liquor) or making *dhindo* (special dough prepared from finger millet). A study conducted in the same community (Ragupathy et al., 2016) reports that finger millet is considered a 'pure' grain (by Janajatis) that is brewed and offered to the God and Goddesses. This could explain the direct and close interaction of Janajati kids with millet consumption and so have more knowledge.

Gender comparison reveals that the average score for formal knowledge was higher among male (67.1%) than female (59.8%)

students, all significant at 0.01 levels in Independent Samples T-Test. This gendered trend is also observed when the informal knowledge spheres – agro-ecological, cultivation, and consumption – are measured separately. For cultivation and overall informal knowledge, the difference is not great, and the data are not statistically significant, whereas the difference in agro-ecological and consumption is high and statistically significant. We found no specific studies that compare gender differences in food literacy, but a study carried out by Setalaphruk and Price (2007) in Thailand shows different patterns for learning related to wild food resources among male and female children: boys were found to be more knowledgeable than girls, but their results were not statistically significant and the context was wild species. Our study was with cultivated species, showing different access for male and female students. Cultivation knowledge was based on their engagement in agriculture on family farms and helping family members with farming activities. The demands of labour on family farms, especially when some family members are absent, compels both boys and girls work on the farm. This minimizes the gender difference in cultivation-related knowledge compared to agro-ecological and consumption categories.

The location of schools shows an effect in the acquisition of formal and informal knowledge. The rural students scored more on agro-ecological, cultivation and consumption (informal) knowledge, while these rural kids scored less in academic performance at school (formal knowledge). On question why urban students have less agricultural knowledge, the schoolteachers had unanimous answer: agriculture is mainly rural occupation and students are expected to help their parents especially during growing season, as agriculture is labour intensive, and labour is in high demand and more expensive during peak season. On contrary, in case of urban students, either their parents do not have access to agricultural land near city, limiting their exposure to agriculture, or kids are sent to the city for study and their expected role is to study rather than being involved in agriculture (see Table 3).

The correlation matrix (Table 4) among selected variables reveals several positive and negative correlations. All correlated variables are statistically significant at a 1% level of significance. The students' age is negatively correlated with formal knowledge while showing a positive correlation with the informal (agro-ecological, cultivation and consumption) knowledge domain.

In focus group discussions (FGD) with schoolteachers after preliminary analysis of the knowledge test data, we found several supporting arguments. In response to our question of why girls are more knowledgeable than boys, a teacher said: 'It is possible that girls have

Table 4
Correlation matrix between formal and informal knowledge domains (N = 226).

Variables	1	2	3	4	5	6
1. Age	1					
2. Agro-ecological knowledge	.563*	1				
3. Cultivation knowledge	.353*	.506*	1			
4. Consumption knowledge	.278*	.475*	.266*	1		
5. Overall informal knowledge	.497*	.869*	.657*	.794*	1	
6. Formal knowledge	-.411*	-.519*	-.303*	-.207*	-.421*	1

Correlations are significant: *at 0.01 level.

more agricultural knowledge than boys because girls are the ones who help parents. Especially with crops like finger millet that are tedious and time consuming, girls help more than boys.'

Looking at the interactions between age and gender on the acquisition of knowledge, the data present interesting scenarios. As mentioned above, formal knowledge was found to decrease with age, while informal knowledge increased for both male and female students. This proves that informal knowledge increases based on interactions with one's environment, which obviously increases with age for both genders. However, the meeting point between formal and informal knowledge comes sooner for girls than for boys (Fig. 2a and b). This means that the pace of decline in formal knowledge among girls is higher than that for boys. In keeping with the sociocultural contexts of the research area (and of Nepal in general) that we observed through our interactions with community people, girls are less encouraged in study at schools and instead are more involved in household and family

farm activities as they grow. In fact, girls are expected to engage in household and agricultural work more than boys are, while boys are expected to focus more on their studies. This observation is supported by our discussion with schoolteachers, described above. A recent Government of Nepal study (CBS, 2015) also reports a higher proportion of out-of-school girls in the total secondary school-age population (57%) than in the primary school-age population (50%), indicating that the dropout rate for girls increases as they grow older.

5. Discussion and conclusions

This paper sheds light on the role of Indigenous food knowledges in shaping food literacy, and how the relationship between this informal knowledge and formal schooling may impact the full food literacy of high school students in the mid-hills of Nepal. Our research highlights the areas of local students' traditional food knowledge and their relationship to social, economic, and spatial factors, including caste/ethnicity, migration (of household members), school's location, age, and gender. We were able to identify a complex connection between out-migration and traditional-food literacy. Although scholars have studied various relationships between migration and food security (Craven and Gartaula, 2015; Crush, 2013), studies on the nature and degree of relationships between migration and food literacy is beyond the scope of this paper and an interesting area for further research.

The caste difference in knowledge acquisition is explained by how a caste group gets engaged with agriculture and culturally relate to local food crop such as finger millets, which in-turn determines how the children are involved in intercultural activities of the crops' lifecycle. This has important implications for intergenerational transmission of

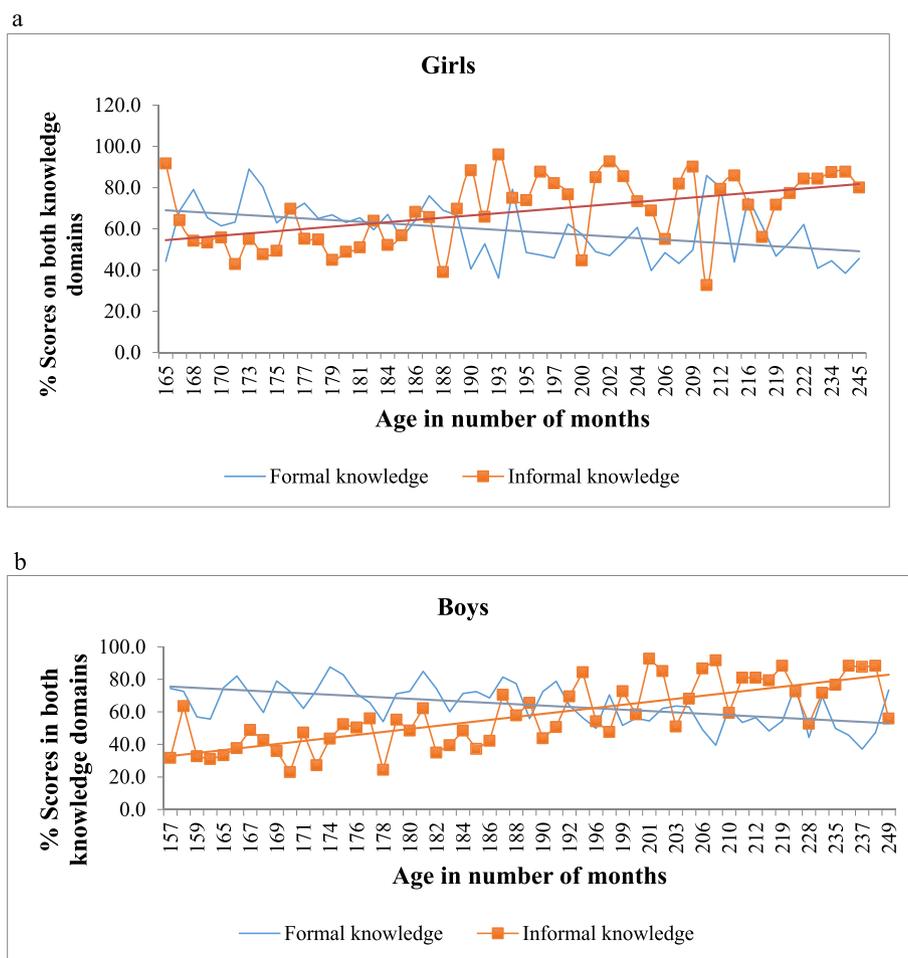


Fig. 2. a) The acquisition of knowledge with respect to age and gender (N = 107). b) The acquisition of knowledge with respect to age and gender (N = 119).

food and agricultural knowledge, contributing to food literacy (Batibo, 2009; Damerell et al., 2013).

The location of schools plays an important role in the acquisition of informal knowledge. The rural students were found better in acquiring informal food knowledge, compared to that of on formal knowledge. This rural-urban divide could be because the rural students have more interaction with local agro-ecology, give hands to their parents in agricultural activities, and at the same time, they may have less time available for school activities. This could potentially offer an opportunity for rural schools to tap into this experiential learning of rural students to promote food literacy. The school gardening program could be an option to promote experiential learning, which is proven to improve food literacy, includes activities such as seed-to-table school food program, taste education, after-school gardening program, nutrition and cooking program, garden to cafeteria program, etc. (Davis et al., 2011; Nowak et al., 2012; Parmer et al., 2009). Malberg Dyg (2014) echoes with this and argues that farm-based or garden-based learning in the curriculum-based education has potential to increase food literacy among students.

The paper reveals an interesting relationship between gender and both formal and informal knowledge on food and agriculture. The informal knowledge performance of both male and female students increases over time with their age. This is obvious, given that they gain more experience as they mature, but what is interesting is that the meeting point between formal and informal knowledge domains happens at a younger age for girls than it does for boys. This points to an opportunity to move this point of interception for female students to a later age so that their retention of informal knowledge will be greater. However, there is always a challenge of 'how to', since this is not simply a function of acquiring different knowledge domains but the outcome of a complex interaction of gender with other intersectionalities prevalent in the Nepalese sociocultural system. One way to address this gender gap in food literacy and academic excellence could be by incentivising girls' education and promoting their retention at school on one hand, spearheading education campaigns in villages on the importance of girl's education and the role of brothers and other family members in their education, on the other. Nevertheless, policymakers could be challenged to consider how formal and informal environments could be restructured as potential avenues for both knowledge domains, creating a synergy to improve total food literacy.

As we discussed with the schoolteachers, girls are faced with more societal and family expectations to offer help in the household chores and on family farms than boys are, which makes the rate of acquiring informal knowledge faster among girls than boys. A teacher FGD participant commented: 'It is possible that girls have more agricultural knowledge than boys because girls are the ones who help parents, especially with crops like finger millet that are tedious and time consuming, girls help more than boys.' This supports arguments for considering Indigenous knowledge as gendered and linked to culturally constructed gender roles and relations. Harman Parks et al. (2015) observed that men and women have different access to assets, gender roles and perceptions about agricultural resources. Wayland (2001) found different knowledge and understanding about medicinal plants among the Amazonian men and women, while Christie et al. (2016) observed a similar pattern about soil pedagogical knowledge in the Philippines, as did Poudel and Sapkota (2016) for cooking skills, buying priorities and interest in gardening in Nepal. We encourage girls to continue their progress in the academic sphere, while for boys more emphasis on acquiring informal knowledge is needed, so that students of both genders can excel in both knowledge domains. To this end, Nowak et al. (2012) argue that schools can create a positive environment for food literacy through experiential learning, which helps students value healthy food in their lives and contribute to food security. Other studies have also observed the positive role schools can play in enhancing food literacy among students (Pendergast et al., 2011; Powell and Wittman, 2018; Ronto et al., 2016).

According to the present system of curriculum development in Nepal, schools can develop part of their curriculum locally (GON, 1992). Schools can take advantage of such an opportunity and develop courses that would ensure parent-student interaction or include Indigenous knowledge. This would not only help integrate formal and informal knowledge domains, but also help promote the conservation of Indigenous knowledge with the help of intergenerational conversation on these issues. However, our discussion with schoolteachers revealed that none of the schools want to offer courses that focus on traditional food literacy. According to teachers, this is just a policy, without financial support from the government. Indeed, implementing such practical courses requires more resources for initiatives such as capacity enhancement of teachers, including developing respectful partnerships with local Indigenous knowledge holders; creating curricular innovations, including land-based pedagogy; and even establishing school canteens that can be accessed to teach hands-on cooking skills using local traditional foods (Ronto et al., 2016; Snyder, 2009; Wildcat et al., 2014). A joint initiative between LI-BIRD and Bioversity International to promote traditional recipes through food fairs has prompted an increased interest in traditional food crops and the motivation to value them (Pudasaini and Gauchan, 2018). This suggests a potential for incorporating such materials into the school curriculum.

It was observed that due to the lack of such curriculum development resources, coupled with existing market demands, schools tend to design courses in such a way that demands fewer resources while still attracting more students. Even in those schools that have a local curriculum in place, it is hardly implemented. In a study conducted on the policies and practices of Nepal's curriculum development, Subedi (2018) reported that no schools had designed or implemented the local curriculum. Instead, all the sample schools replaced local curricula with English language courses. The main reason behind such practice was the lack of technical knowledge in concerned stakeholders, as well as poor or non-existent mentoring and supervisory practices from government agencies. In such arrangements, community discourse and local support matters much more than the provision in policy. A schoolteacher from our study said: 'Parental and community support is important to promote such courses that enhance food literacy and Indigenous knowledge. However, parents would not be interested to send their kids to learn about millet cultivation or preparing food. Everyone likes computer science or management kind of courses in the school.'

In research in Germany involving response from the community on imparting cooking skills in schools, a significant number of respondents (36%) favoured informal learning, with the school curriculum taught by parents at home (Pendergast et al., 2011). In Canada, the British Columbia farm-to-school movement has promoted institutional procurement of local foods and mobilization of food literacy (Powell and Wittman, 2018). Likewise, Poudel and Sapkota (2016) maintain that school gardening could be an ideal programme for enhancing food literacy among students in Nepal. Taking these findings into account, we argue that providing a local curriculum has the potential to promote food literacy, but requires public support, political commitment (government support for logistics as well) and awareness about Indigenous knowledge on human health, environment and sustainability.

Moreover, to enhance food literacy among youth school interventions (by integrating curriculums) should go hand in hand with the mainstream agricultural extension system. Otherwise, even if youth are food (or finger millet) literate, informal sources and Indigenous knowledge may not be sufficient; they should be backed by the formal extension education system to legitimize their knowledge. The challenges of incorporating Indigenous knowledge within elementary and secondary schools including granting the same legitimacy and importance to Indigenous knowledge as formal school-based knowledge were examined by researchers in recent time (Hatcher, 2012; Massey and Kirk, 2015; Mpofu et al., 2014). However, since agricultural extension education is only taught at the post-secondary level, a policy intervention is needed to bring this issue out in the mainstream. Youth

could also be engaged in non-formal extension education models such as farmers field schools, farmer groups, local service provisions, and agri. entrepreneurship (Erbstein et al., 2017; Westendorp, 2012). This is, in fact, a good opportunity to engage schools for better outcomes of agricultural extension education system and engage youths in food literacy campaigns so that they could transform agriculture as a respected profession of choice for the new generation of farmers. Moreover, rural students have potential to contribute to food literacy in the school community, provided the schools create appropriate space for experiential learning. We, therefore, recommend policy makers to tap this opportunity and transform agriculture in the new political regime, as agriculture is in the mandate of local governments and they are better placed to devise such location specific policies.

Finally, in our case study from Nepal, high school students demonstrated how their food literacy is configured largely through traditional-food knowledge and through informal sources such as their families and communities. The role of formal schools in strengthening food literacy remains minimal. To attain the goal of community food security for current and future generations in the rural and farming communities of Nepal, a revalorization of traditional-food literacy among young people is just as important as the rediscovery of traditional foods such as millets. The school-based examples and initiatives that we referred to, largely from other communities, including land-based pedagogy, biodiversity contests and school canteens, all call for experimentation and innovative adaptations. An example of such curricular innovations have started emerging at the university level (see for example, the University of Winnipeg's land-based courses on Indigenous food systems: <https://news-centre.uwinnipeg.ca/all-posts/learning-about-Indigenous-foods-in-the-field/> and [Indigenous Ethnobotany \(https://news-centre.uwinnipeg.ca/all-posts/medicine-walks-and-scientific-method-unite-in-unique-field-school\)](https://news-centre.uwinnipeg.ca/all-posts/medicine-walks-and-scientific-method-unite-in-unique-field-school/)). Even though the academic knowledge gained through formal schooling does not interact favourably with a community-based informal knowledge of traditional foods, we hope that schools can create pedagogical spaces where both formal and informal knowledges interact synergistically to enrich food literacy and enhance community food security. The cultivation of current and sustenance of future food literacy calls for holistic, transformative and innovative social learning for pedagogical innovations that involve participation of a diverse range of actors including local community, students, teachers and school administrators and governments.

Declaration of competing interest

We declare to have no conflict of interest.

Acknowledgements

The Social Sciences and Humanities Research Council of Canada (SSHRC) financially supported this research under its Postdoctoral Fellowships Program. The research also received support from the Canadian International Food Security Research Fund (CIFSRF), a program of Canada's International Development Research Centre (IDRC), undertaken with the financial support of the Government of Canada provided through Global Affairs Canada. The University of Winnipeg discretionary research grant is thankful for providing financial support for language editing. The authors are indebted to Maureen Epp for her assistance in proofreading the manuscript and to Gokul Prasad and Alfredo González Ramos of CIMMYT for producing map of the research area. The authors are grateful to Khem Subedi and Shirmala Yonjan of LI-BIRD Nepal for providing logistical support during the fieldwork, and to the anonymous reviewers for their valuable comments to improve this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jrurstud.2019.12.001>.

doi.org/10.1016/j.jrurstud.2019.12.001.

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