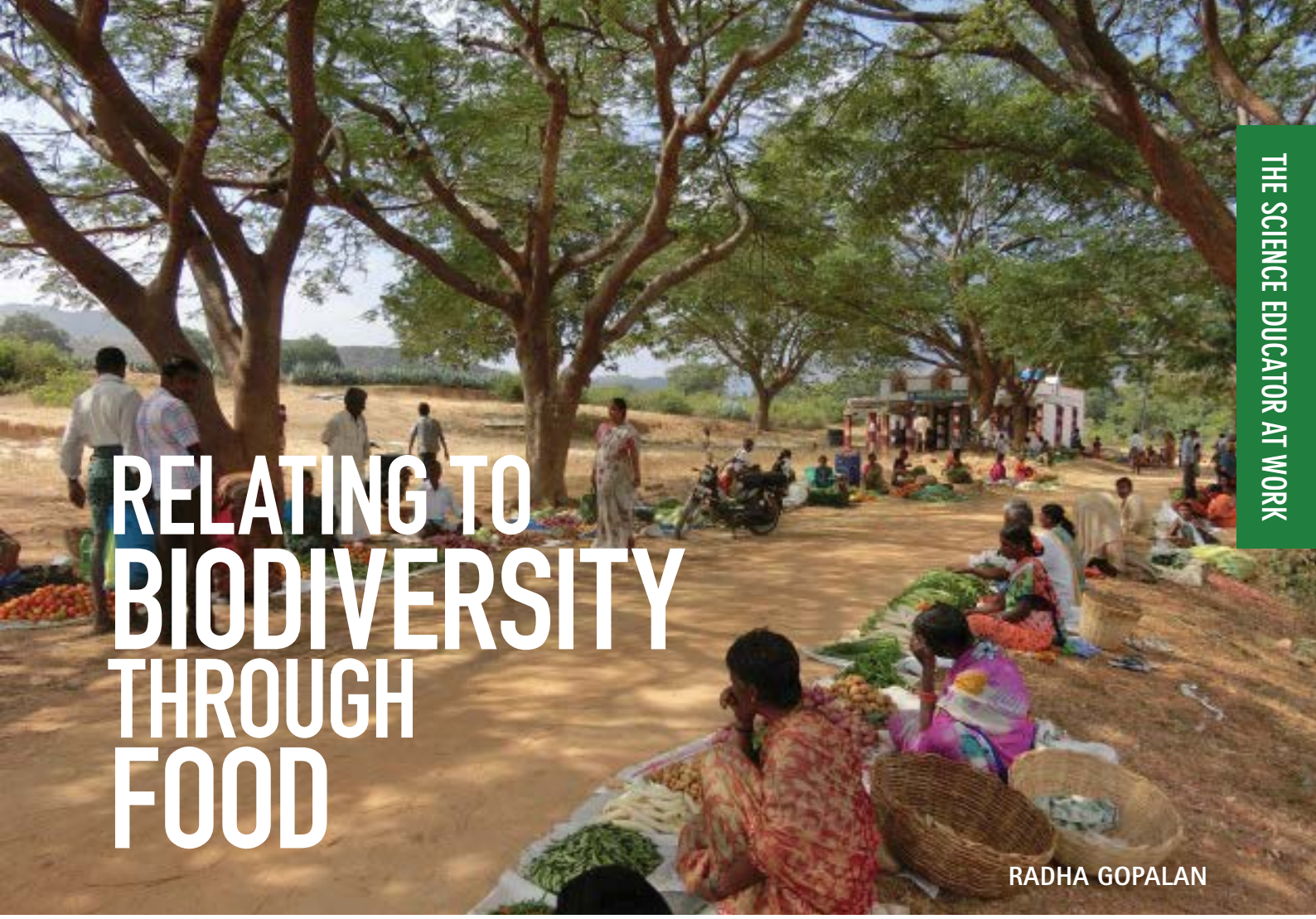

RELATING TO BIODIVERSITY THROUGH FOOD

RADHA GOPALAN

The concept of biodiversity is usually introduced in middle school in the context of forests, wildlife, and protected areas. But is it possible to relate to this concept through the diversity in our local food systems?

The concept of biodiversity is introduced in a chapter on 'Conservation of Plants and Animals' in the Grade VIII science textbook as: *"the variety of organisms existing on the earth, their interrelationships and their relationship with the environment".*[1] This definition is accompanied by images of tropical forests and protected areas with large wild animals. Many students may find these examples alien to their real-world observations and experiences. This disembodied way of relating to biodiversity can limit their understanding of this concept to knowing the term and remembering its definition to pass examinations. Therefore, the main challenge for teachers is to find ways to help students relate to biodiversity in their local lived contexts.

In this article, I share some learning experiences from how teachers and students at a local Zilla Parishad High School (ZPHS) in rural Andhra Pradesh addressed this challenge by exploring the diversity of their local food systems.

Biodiversity in a semi-arid landscape

Located in the semi-arid Rayalaseema region of Andhra Pradesh, ZPHS is surrounded by a mosaic of scrubland grasses, hillocks, agricultural fields, and a few patches of dry deciduous forest (see **Fig. 1**). Its students belonged to a rural community of pastoralists and small farmers. A small group of us, who lived and taught in a residential school in the area, worked closely with teachers from the ZPHS, supporting them with ideas for lesson plans and teaching resources.

During one of our discussions, the Grade VIII biology teacher sought our help in setting up a public exhibition on the occasion of the International Day of Biodiversity. She shared how her students were unable to relate to the concept of

Fig. 1. The semi-arid landscape of Rayalaseema.
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biodiversity because they had not seen any of the plants or animals mentioned in relation to this concept in their textbook. Therefore, she intended to introduce them to the diversity of tree species native to the dry deciduous forests of the region. For this purpose, she wanted to borrow well-grown saplings of a few such tree species from the nursery of our residential school, which her students would present in the public exhibition. In preparing for their presentation, the students would have the opportunity to learn more about each of these species, and their role in the local forest and landscape.

At the time, we were engaged in an ongoing dialogue with the local community to understand and document the diversity in their traditional food systems. This led us to suggest an alternative to the teacher—what if her students were to prepare exhibits to capture the diversity in local food crops, vegetables, leafy greens, berries, fruits, etc.? This could be an excellent way for students to learn to connect concepts in their textbooks with their real-world experiences. It would also allow them to showcase the knowledge and lived experience of agrobiodiversity embedded in their own community.

The biology teacher as well as the other teachers who were helping with the exhibition were willing to give this a try. They requested our help in working with the students to plan, collate information, and set up the exhibition. While the students were not able to immediately relate this to what they had learned about biodiversity in the classroom, they greeted the idea with a lot of excitement and questions. With the planning of the exhibition being a priority, we agreed to come back to the students' questions after the preparations were done.

From planning to preparation

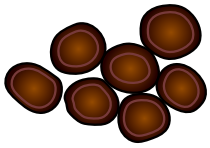
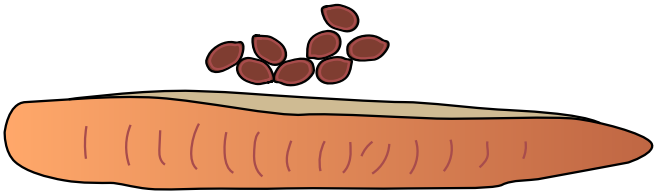
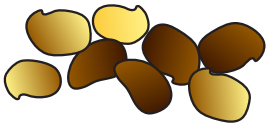
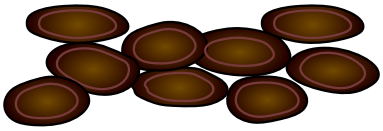
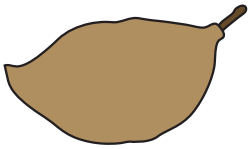
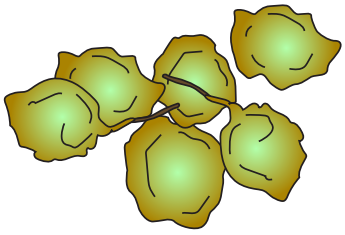
The students of Grade VIII came from eight villages in the area—some located in the hills and others in the valley. This topography influenced the availability of groundwater, precipitation patterns, soil type, and access to the nearby town market. As a result, these villages differed in the crops they grew, how they grew them, and the breeds of animals they reared (see **Box 1**). After much discussion among the students and teachers on what to include as exhibits, it was agreed that each student would bring samples of the seeds of traditional or local grains, vegetables, edible greens, and fruits available in their homes. They were specifically asked not to procure commercial seeds. Students were also encouraged to consult their parents, grandparents, and other elders in the village for information on each seed and record this in their notebooks.

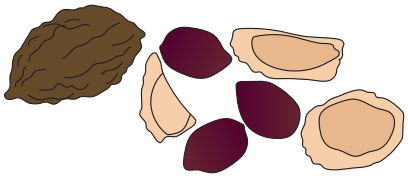
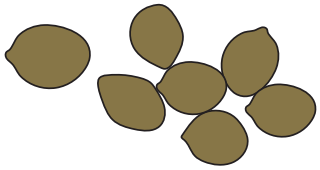
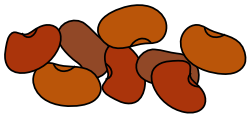
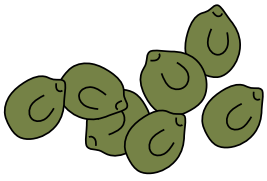
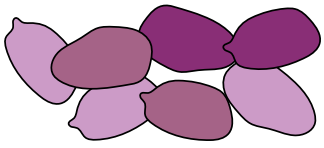
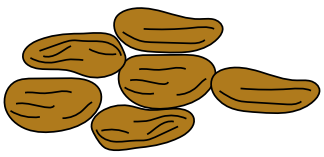
Preparation for the exhibition began in earnest as the students started bringing in seeds of different varieties of millets, dryland paddy, oilseeds, leafy edible greens, gourds, and other vegetables. As each student shared the information they had collected, the teachers were amazed at how much knowledge existed in the community, and how easily the students related to it. Similarly, when the students took stock of the many different seeds and the amount of information they had collected, they were surprised by the diversity of both, even within a single village (see **Table I**). Much of what they had documented

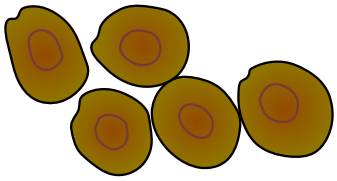
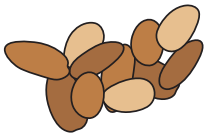
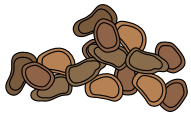
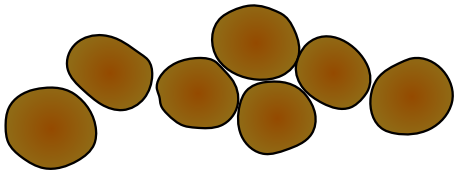
Box 1. Diversity of food plants in the area:

The traditional food system of this region was built on a diverse range of food crops (millets, pulses, oilseeds, and dryland paddy), herbs, uncultivated edible greens, gourds, and berries. Some of these were cultivated, and others foraged (uncultivated). The kind of food crops seen in any particular part of the region depended on its topography, soil conditions, and water availability. In the hills, for example, people cultivated dryland paddy, oil seeds, 7-8 varieties of millets, cluster beans, as well as a wide range of gourds and chillies; and foraged for many wild edible leafy greens, tubers, and berries. In contrast, people in the plains cultivated tomatoes, chillies, brinjals, very few gourds, and 3-4 varieties of millets; and foraged for many wild edible leafy greens from the fields, bunds, and uncultivated areas.

Table I: Seeds of local tree species from a farmer's collection

Sl. No	Botanical Name	Telugu Name	Image of seed
1.	*Acacia nilotica*	Nalla thumma	
2.	*Leucaena leucocephala*	Kanti subabul	
3.	*Dalbergia paniculata*	Pachari	
4.	*Acacia leucophloea*	Tella thuma	
5.	*Hemidesimus indicus*	Pala	
6.	*Pongamia pinnata*	Kaanuga	
7.	*Pterocarpus santalinus*	Rakta chandana	

Sl. No	Botanical Name	Telugu Name	Image of seed
8.	*Zizyphus jujube*	Reni	
9.	*Elangium salvifolium*	Ooduga	
10.	*Wrightia tinctoria*	Palavareni	
11.	*Seisbania grandiflora*	Avisi	
12.	*Acacia catechu*	Sandra	
13.	*Syzygium cumini*	Alli Neradu	
14.	*Azadirachta indica*	Vepa	

Sl. No	Botanical Name	Telugu Name	Image of seed
15.	*Melia dubia*	Pedda vepa	
16.	*Albizzia lebbeck*	Pedda Sandra	
17.	*Albizzia amara*	Chigara	
18.	*Annona squamosa*	Sitapalam	
19.	*Calotropis gigantea*	Jilledu	
20.	*Litsea glutinosa*	Nara mamidi	
21.	*Boerhavia diffusa*	Punarnava	

came from their own real-world observations and experiences. For example, many of the students helped their families with farming; and knew how seeds were selected, stored, and tested for their viability before planting. They also knew of many traditional cultivation practices that were used to conserve the fertility of their soils and local plant varieties (see **Box 2**).

Arriving at a shared understanding

The exhibits were ready two days before the exhibition. Students had arranged the seeds in small containers, labelled them, sketched colourful images of plants that the seeds would grow into, and recorded all the information they had collected on charts. It was time to come back to the students' questions on how their exhibits (of local plants that contributed to their food system) were connected with the textbook definition of biodiversity (the theme of the exhibition).

We started the discussion by listing the many varieties of millets and gourds that were able to adapt well to the local conditions because of their ability to grow on marginal soils, and tolerate heat and drought. We also discussed the many local varieties of vegetables, pulses, and oilseeds that had evolved resistance to local pests. This led to a discussion on how the crop varieties cultivated on the hills were different from those cultivated on the plains.

This allowed students and teachers to explore how differences in soil, rainfall, and microclimates within the same region can influence the diversity of organisms in different areas.

This led to a discussion on the local ruminant and fowl breeds that had adapted to survive on the local scrub vegetation and were able to tolerate the water-scarce, hot, dry summers of the region (see **Fig. 3**). These drought-resistant breeds contributed to the food system by providing meat, milk, manure, and a means for livelihood. The students wondered about other animals that fed on the food crops—including the insects and birds that were found on or visited their fields. Were these too part of the local biodiversity? It was through

Box 2. Local agricultural practices to conserve soil fertility and local plant varieties:

Since most of the landholdings were small (less than an acre to two acres), the local community had developed practices that helped maximize the food, fodder, and fibre that they could produce or forage from the land. To grow diverse plants (grains, pulses, oilseeds, vegetables) on the same piece of land, they used multicropping and /or intercropping practices (see **Fig. 2**). This meant that certain crops were grown in combination (like certain kinds of millets intercropped with leguminous plants like pigeon pea, oil seeds, or vegetables). Another practice involved the sowing of seeds at differing depths based on their size. This meant, for example, that smaller finger millet seeds were sown closer to the surface for better germination, while larger kodo millet seeds were sown at more depth so that their tender roots were not exposed at germination.

Fig. 2. Multicropping of grain, oilseeds, and vegetables in a field where minimal weeding is done.

Credits: G. Nandakumar. License: CC-BY-NC.

Traditional practices for the rejuvenation of soil health included manuring, soil moisture protection using shade crops and mulching, and seasonal variations in crop choices. Many of these farmers were able to identify specific pest attacks on plants by observing changes in leaf appearance and texture, the presence of protuberances or fungal growth on the stem, etc. The farming community had developed practices and formulations to manage some of these pests. Most of these practices allowed the fields to remain habitable for insects, worms, reptiles, frogs, and birds; and some of these, in turn, helped control crop pests. Since the farm animals (like cattle, goats, and sheep) grazed and browsed in the surrounding forest and on the hillocks in the area, their dung would contain the seeds of local uncultivated herbaceous species that would take root and grow in cultivated areas. Weeding was minimal and typically took the form of local women harvesting edible greens for food. Local species of agave (*kalamanda* in Telugu) were used as live fences, and hardy non-native species such as *Seisbania grandiflora* were used as windbreakers and mulch. In this way, traditional practices helped conserve many local and non-local non-food plants. Underlying these practices was the knowledge that this community had developed, over many generations, through sustained observation and learning from experimentation.

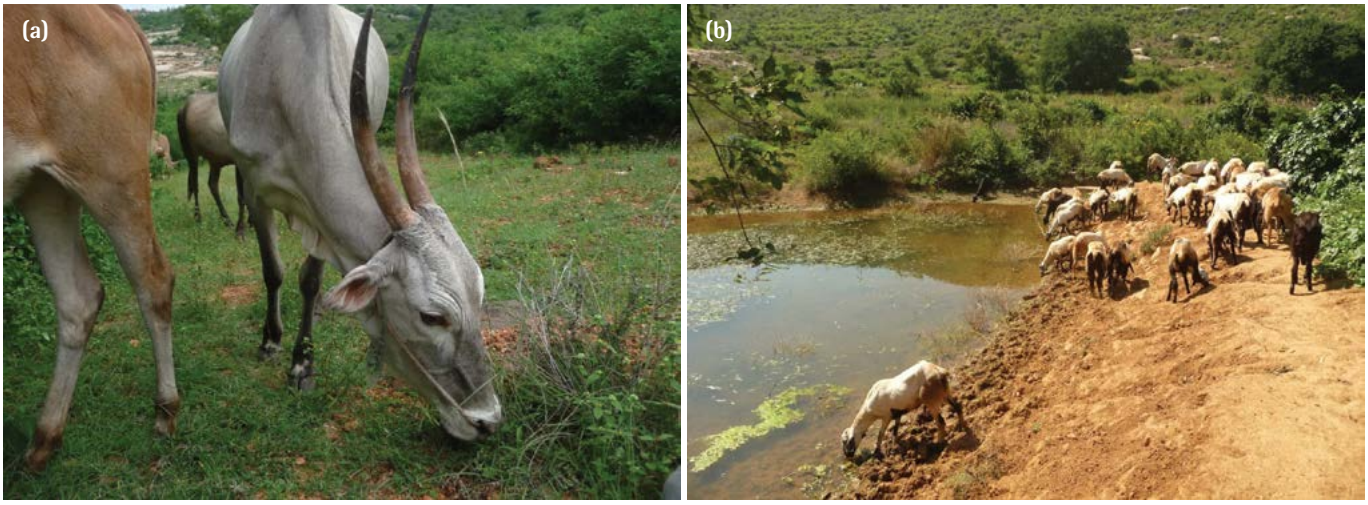


Fig. 3. Hardy local species of cattle and goats that have adapted to the water-scarce, hot, and dry landscape. The hardy Hallikar breed of cattle seen in (a) are grazing animals reared for both dryland agriculture and milk. The sheep (white-and-black) seen in (b) are of a local hair breed reared primarily for meat. Similarly, the goats (black) seen in (b) are of a local hardy breed reared for meat. Since these animal breeds require minimal resources, they are of immense value in this resource-fragile region, especially in the face of the increasing uncertainties of climate and resource availability.

this question that we were able to explain how the biodiversity of an area extended beyond the plant varieties and animal breeds (whether indigenous or commercial) that provided us (humans) with food to include all the different kinds of organisms found there and their interrelationships. And that this included all the plants (the trees, grasses, shrubs—even those that were seen as weeds); animals (like birds, snails, bats, insects—even those that were seen as crop pests); and microbes (like bacteria and fungi—even those that were seen as pathogens) that lived in and built the soil.

This prompted questions on the many factors and interactions that shape the biodiversity of an area and our (human) role in this. In response, we explored the ways in which our many activities (including our farming practices, how and where we graze our animals, and where we build our houses) could influence the kinds of organisms that we saw around us and their dynamics. Limitations of time did not allow for a deeper discussion on differences in the nature and richness of biodiversity in cultivated and uncultivated areas, or the effect of cultivation practices on the biodiversity that existed before the land was cleared and prepared for cultivation. Teachers interested in using this article to encourage students to explore biodiversity in their local contexts might like to build this into their lesson plans.

From the exhibition to the classroom

The teachers of the ZPHS felt that the exhibition had been a great success

Box 3. Reactions of visitors to the exhibition:

"This is the first time I have seen my students expressing themselves so confidently. (Especially) the way they answered questions. I was so surprised at how well they were able to explain the relationship between soil, water, seasons, and the food they grow!" — Grade VIII, science teacher.

"I could not believe it was our Grade VIII students. They were able to answer all the questions about their exhibits. How did they know all this? A lot of this information is not from their science textbook." — Headmaster, ZPH school.

"Three, four of us were answering many questions like, why we grow millets, pigeon pea, and oil seeds in the same field, how it improves and protects the soil and groundwater, how mulching and green manure made from many different kinds of leaves is important for soil bacteria and fungi. As we were explaining these things, they became even more clear to me." — Grade VIII student.

"As a Grade IX student I was very surprised to learn so much about why and how we can protect our jeevavaividyam. We should do more such activities as part of our studies..." — Grade IX student.

"We never went to school. So when my grandchild told me that our stories, our seeds will be in an exhibition on jeevavaividyam I was very curious. How well they have understood the importance of jeevavaividyam in our life. They need it for their future..." — A student's grandparent.

"I have studied only up to Grade VII and studied a little bit of science but that had no connection to our farming, our work, and life. I learned today from our children how our knowledge of seeds, local plants, our food culture, our animal breeds are related to what they are learning in school and that too in science..." — A student's mother.

(see **Box 3**). Reflecting on their experiences allowed us to identify several ideas on how this learning could be connected to the curriculum. For example, information on traditional crops and farming practices could be directly connected to the chapter on 'crop production and management' in the Grade VIII social studies textbook. Similarly, the relationship between water resources and water conservation in the Grade VII science textbook could be explored by relating it to the crop choices in this semi-arid region, the plant adaptations that influence these choices, and the way these are grown. We were also able to identify topics in the Grade VII-IX textbooks for which similar activities could help students explore the connections between soil fertility, food production, and the microbial world in local contexts (see **Box 4**). Lastly, involving the families of the students in the preparation and display of exhibits opened up the potential for creating more such opportunities for meaningful intergenerational learning.

Parting thoughts

As they worked on putting together the exhibition, the students and teachers of ZPHS started exploring the relationship between local food systems and the larger environment. Rather than seeing biodiversity as a scientific concept that applied only to forests and protected areas, students were able to relate this term to their local context and lived experiences.

The exhibition also presented a unique opportunity for the rural farming community, school teachers, and students to come together. Learning from such projects can help students develop an appreciation for the knowledge that resides in their communities. Recognizing that knowledge can come from multiple sources can help build students' confidence in being active participants in their own learning. As a result of this intergenerational learning effort, many students became interested in our ongoing efforts with their community to document the agrobiodiversity in their traditional food systems. Some of the students started attending and often participating in these discussions. This may have sown the seeds for a deeper understanding of how the land, people, and other organisms around them form a network of interdependent relationships.

Box 4. Topics in the NCERT science syllabus that can be used to connect students' real-world experiences to the science classroom:

Grade VII: Soil—our life

Grade VIII: Microbial world (soil diversity), Food production from plants, Food production from animals

Grade IX: Natural resources, Improvement in food resources

Key takeaways

- Engaging students in an investigation of the food systems and practices of their own community allows them to understand the many factors and interactions that shape biodiversity in their context, and our (human) role in it.
- Creating opportunities for intergenerational learning around traditional food production practices can help students appreciate the knowledge that resides in their communities.
- Working on such projects can help students understand that knowledge can be built from the classroom as well as lived experience, build their confidence, and help them become active participants in their own learning.

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