Research article

Improvements in Agricultural Education at Secondary Schools in Nepal: A Case Study in Mustang District

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Abstract The Nepal government introduced Technical Vocational Education to secondary schools nationwide in 2014 as part of its School Sector Reform Plan (running from 2009 through to 2015). The purpose of agricultural education in secondary schools is to develop a workforce to support the nation's agricultural development and alleviate poverty. This case study analyzes the current status of and issues with agricultural education at a secondary school in Nepal's Mustang District. First, the curriculum and syllabi of the Plant Science Stream program were reviewed. Second, the school's teaching activities were analyzed and compared with the teaching methods in use at a Japanese agricultural high school in the Nagano Prefecture. The head of the school and a teacher of agriculture conducted observations and interviews regarding the Japanese high school's teaching practices in September 2017. After observing the Japanese high school, focus group discussions were conducted with five other agriculture teachers at the targeted school in Nepal. The discussions found that the content of the lectures did not adequately explain local farming practices. It was determined that the study program should conduct cultivation trials of local products in the school farm. Students could interview local farmers and observe their crop production, agro-processing, livestock rearing, and natural resource managements. Students could practice farming to use the products for their own consumption or sales at school and local markets. These activities can strengthen students' understanding of agricultural information and techniques. The suggested activities would also allow the teachers to learn what information to include in the lectures and practices to support students' knowledge of farming practices relevant to the local area.

Keywords Nepal, mountain area, rural development, practical education

INTRODUCTION

A quarter of Nepal's total population of 27 million falls below the poverty line. More than 80% of the population lives in rural areas, and 73% are engaged in agriculture. Agriculture accounts for 33% of Nepal's gross domestic product (World Bank, 2017). Nepal's National Strategy Plan (13th three-year plan) aimed to improve living standards and reduce poverty to 18% by 2020 (National Planning Commission, 2013). Furthermore, the Ministry of Agriculture Development (MoAD) (2016) prioritized the strengthening of agricultural education to improve agricultural productivity and reduce

poverty. However, public agricultural extension services have been limited to reach the rural farmers due to lack of the budget, infrastructure and qualified extension workers. In addition, the supply driven extension approaches rather than demand driven have been failing to cater the needs of the farmers (Dhital, R.P. 2017). Technical and Vocational Education and Training (TVET) program under the Council of TVET have allocated 175 training centers in different areas of Nepal but they are mainly in urban areas. Agricultural training service are also limited in only 20 training centers (Asian Development Bank, 2015).

In 2013, as a part of Nepal's School Sector Reform Plan (2009-15), the Ministry of Education (MoE) established a technical and vocational education (TVE) program in secondary schools, covering the 9th, 10th, 11th, and 12th grades (MoE, 2009; MoE, 2016). The TVE program includes Plant Science, Animal Science, Civil Engineering, Electrical Engineering, and Computer Engineering. The aim of introducing the TVE program was to promote technical studies and facilitate the development of practical engineers who could contribute to Nepal's economic development and poverty alleviation (MoE, 2016; Santwona Memorial Academy Pvt. Ltd., 2017). The Plant Science Stream program aims to attract students to pursue higher education in the subject who can then work in agricultural organizations or companies and promote the role of local agricultural businesses and farming within the overall economy (MoE Curriculum Development Center, 2015; MoAD, 2016). In 2014, the MoE introduced five TVE program in 99 model schools nationwide (MoE, 2015; Santwona Memorial Academy Pvt. Ltd., 2017). As of 2017, 284 schools had adopted a TVE program in secondary school, including 94 which introduced the Plant Science Stream, the largest among all the programs (MoE, 2018).

The Plant Science Stream in secondary schools is expected to enhance the capacity development of national human resources to promote agricultural and rural development in Nepal. However, there is no study, yet which clarifies the current situation since agricultural education has only recently been introduced in secondary schools.

OBJECTIVE

This study analyzes the current status of agricultural education, focusing on Plant Science Stream in secondary schools in Nepal, and identifies issues and ways to improve the program.

METHODOLOGY

This study employed action research which involved both the researchers and targeted beneficiaries, agricultural teachers in this case, to address the existing issues together (Greenwood and Levin, 1998). Education research has often utilized action research for not only teachers' learning to develop teaching methods and skills but also the solutions of significant problems in classrooms and schools (Gregory S. C. Hine. 2013). A teacher or a group of teachers try to identify the issues in their classes and come up with causes and possible solutions with a concrete action plan to apply to the actual lessons as trials. The trial results are monitored and evaluated to ascertain the effectiveness of the solutions. This process is often repeated until addressing the issues and the findings can be shared with other teaching staff and researchers as a valuable reference for further developments (Greenwood and Levin, 1998; Gregory S. C. Hine. 2013.).

This study tried to identify the issues of the teaching methods and other related environments of the surveyed school through the observation of those in Japan for comparison, and several focus group discussions to identify the issues and necessary action plans to solve them with the researchers' facilitation. A targeted secondary school for this study was selected in a mountainous area where the altitude is around 2,600 m in the Mustang district of Nepal (MP RC, 2017). The school introduced the Plant Science Stream in 2014 when the TVE program had just started in Nepal (MoE, 2016). Observations were conducted in December 2016 and again in August 2017, a survey was first conducted comprising observations of lectures and practices; interviews with teachers on their teaching methods; and reviews of the curriculum, syllabi, and teaching materials in a Plant Science

Stream at the targeted school. A questionnaire survey was conducted with the students to record their background, the agricultural experiences of their family, and their career expectations.

Second, in September 2017, to identify the educational issues, joint observations were conducted in a Japanese agricultural high school in the Nagano Prefecture with the head of the targeted school, an agriculture teacher at that school, an MoE officer, and the researchers. The observation team compared their own education at the targeted schools in Nepal with the education system and teaching practices at the Japanese agricultural high school. Thereafter, in November and December 2017, the teachers led several focus group discussions with five other teachers of agriculture at the targeted school, through the facilitation of the researchers.

Fig. 1 Target area in Nepal

RESULTS AND DISCUSSION

Teachers and Students of the Surveyed School

As of August 2017, the targeted secondary school had seven teachers in charge of agricultural subjects and six teachers for general subjects. The agriculture teachers came from areas that were all located at altitudes much lower than that of the Mustang district. The school had 29 students in the 9th grade, 16 in the 10th grade, 20 in the 11th grade, and 16 in the 12th grade. The 12th-grade students were the first group to join the Plant Science Stream of the targeted secondary school.

Table 1 indicates the results of a questionnaire completed by the 12th-grade students in December 2016, when they were in the 11th grade. The students originated primarily from the same village development committee (VDC) area of the surveyed school and neighboring VDCs. Some students came from areas far away from the school or urban areas. The school offered dormitories, kitchen facilities, and dining rooms for out-of-area students. The parents of 13 out of the 14 respondents were engaged in agriculture. The chief crops cultivated as staple foods were maize, potatoes, buckwheat and legumes. Most families grew vegetables and fruits such as carrots, radishes, cabbages, cauliflowers, apples, walnuts, and potatoes are planted as cash crops in the region to be sold to markets in the urban areas. Certain staple foods were generally grown on farmlands using a seasonal crop rotation system. Vegetables and fruits were generally grown in small fields near homes, or in backyards. Regarding students' plans after graduation, seven students aimed to study agriculture in university and seven students planned to work in agriculture.

Table 1 House business and expected careers of the students (December, 2016)

House business	Agriculture: 13 (Maize, Barley, Wheat, Buckwheat, Potato, Common bean, Wild bean, Carrot, Radish, Cabbage, Cauliflower, Apple, Walnut)/ Non agriculture: 1
Expected career after graduation	Agriculture: 7 (4 males and 3 females) , Study in university: 7 (6 males and 1 female) Expected faculty to be enrolled: Agriculture 6, Other 1

Note: Respondents were 14 (Male: 10, Female: 4) out of 16 students in the 12th grade

Curriculum and Syllabus

The curriculum for the Plant Science Stream at the targeted school included general subjects, such as Nepali, English, Mathematics and Science subjects, as well as agricultural subjects which are shown in Table 2 (MoE CDC, 2015; Higher Secondary Education Board, 2015). Each subject has a syllabus covering the course content including the teaching times, objectives, study outcomes, content of theory and practice, and evaluation criteria and methods. Agricultural subjects encompassed a step-by-step learning process from basic knowledge and techniques required in the 9th grade to more specific and subdivided subjects in the 10th to 12th grades. The curriculum also required 3,100 hours of practical work in four years.

Table 2 Agricultural subjects of Plant Science Stream in the surveyed school

Grade	Subjects
9	Principle of Agronomy / Principles and Practices of Fruit Crop / Plant Protection / Soil and Soil Fertility Management / Extension and Community
10	Vegetable and Medical Plant / Floriculture and Nursery Management / Crop Protection / Farm Management and Marketing / Aquaculture and Fisheries / Industrial Entomology and Mushroom
11	Commercial Fruit Production and Orchard Management / Food Crops Production and Food Security / Participatory Agriculture Extension and Marketing
12	Commercial Vegetable Production and Marketing / Sustainable Integrated Nutrient and Pest management / Commercial mushroom production and marketing

Table 3 Syllabus "Principles and Practices of Fruit Crop Production" in the 9th Grade

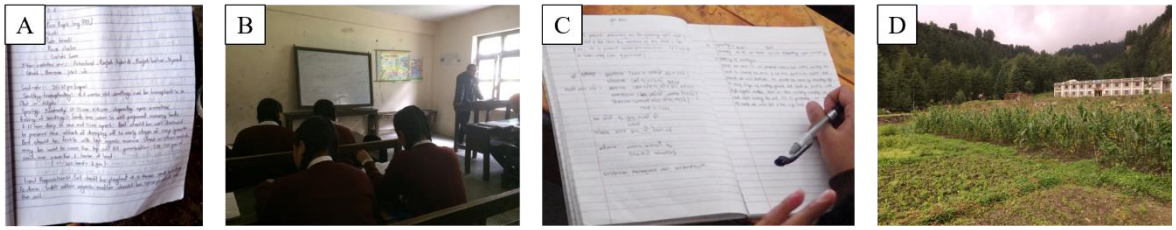
[Theory] 1. Introduction: 1.1 Meaning & definition of horticulture and branches. 1.2 Importance & scope of horticulture. 1.3 Types of fruit crops (tropical, subtropical, and temperate) found in Nepal. 2. Climate: 2.1 Environmental factors affecting fruit production. 2.2 Role of climate on fruit distribution. 3. Home garden, 4. Orchard management, 5. Plant growth, 6. Plant growth regulators, 7. Cultivation of fruit crops, 8. Harvesting and post-harvest handling of fruits. [Practical] 1.1 Identify fruit / plantation crops. 1.2 Identify horticultural tools / equipment. 2.1 Lay-out orchard / tea garden. 2.2 Perform digging and filling of pits and planting of fruits. 2.3 Perform training and pruning of fruit and plantation crop. 3.1 Fertilize / manure fruit trees. 3.2 Prepare Bordeaux mixture / paste. 3.3 Practice cutting / layering / grafting. 4.1 Study the equipment/tools used for preservation. 4.2 Study ripening of banana. 4.3 Perform dehydration and water loss of different fruits. 4.4 Prepare jam / jelly / ketchup / juice / squash / pickles. 4.5 Prepare green coffee.

On completion of the first agricultural course, Principles of Agronomy, which covers the basic knowledge of agronomy and cultivation environments, including plant physiology, soil management, cropping systems, water management, and post-harvest management, students undertook Principles and Practices of Fruit Crop Production which was conducted in the same year. As Table 3 illustrates, the syllabus focused on the basic knowledge of fruit production, and on commercial fruit production and orchard management, which focused more specifically on all kinds of existing Nepalese fruits from tropical, subtropical, and temperate areas. The class included practical and applied knowledge

on production skills, farm management, and marketing and distribution systems. Teachers covered tropical and subtropical fruits in lectures, and temperate fruit crops were introduced later. Practical activities offered the experience of identification of fruit crops, the orchard setting, field preparation, fertilization, grafting, pest control, harvesting, and processing (MoE CDC, 2015).

Teaching Methods in Nepal and Japan

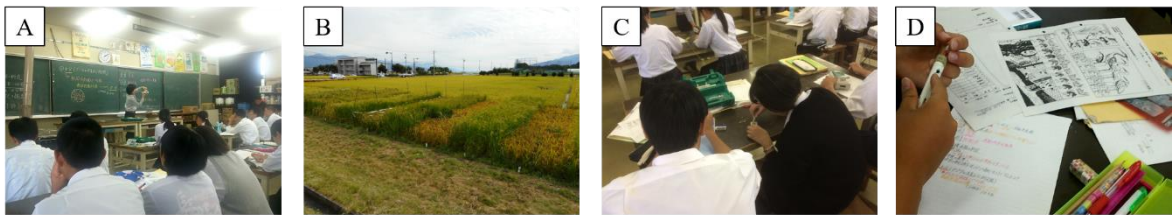
At the surveyed school in Nepal at the time of this study, textbooks or teaching manuals were yet to be created for the Plant Science Stream. Therefore, as Fig. 2 shows, teachers had to prepare teaching notes based on the reference books recommended in the syllabi. Moreover, the students studied later from their lecture notes. In class, the teacher explained the content of the teaching notes orally and by writing on the whiteboard. Additionally, cultivation practice was conducted in the school farm. At the beginning of agricultural education in 2014, one hectare of school farmland had been developed, and cultivation practice was conducted each year.



Teaching note | Lecture | Student's note | School field

Fig. 2 Teaching environments in the surveyed school

On September 5th, 2017, teaching activities in the subject Agriculture and the Environment were observed in a Japanese agricultural high school. As Fig. 3 shows, the teacher first explained in the classroom about rice grain maturity and the appropriate timing of harvesting based on the moisture content of the rice. Second, the teacher guided students to conduct field observations on differences in rice maturity, depending on the varieties. Students sampled the rice stalks with paddy from different varieties to measure the moisture. After returning to the classroom, the students drew diagrams of the rice stalks and measured the moisture of the paddy to prepare a report. The classes covered the entire production process and growing stages of rice, including the preparation of the paddy fields, seeding, transplanting, growth, and harvesting. The theory and practice were interconnected, as Fig. 4 shows.



Demonstration in lecture | Rice production trial | Measuring seed moisture | Report writing

Fig. 3 Integration of teaching methods, lectures, field practices, and teaching material at the Japanese agricultural high school

Issues and Improvement Plan Based on the Focus Group Discussions

(1) Prioritizing local products in lectures and connecting theory with practice:
In the focus group discussion, the teachers suggested focusing more on local agricultural products, although they recognized the importance of knowledge of Nepalese agriculture in tropical, subtropical, and temperate areas. These teachers felt that local farming practices should be integrated into the cultivation practices on the school farm and into the teaching of theory in lectures.

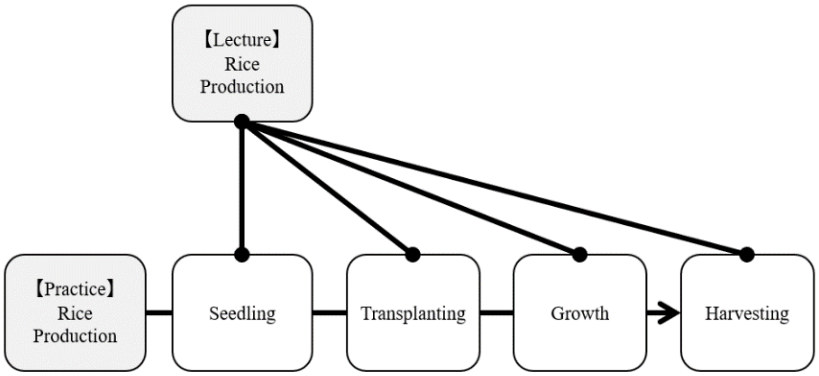


Fig. 4 Integration of the lecture and field practice at the Japanese agricultural high school

The discussion indicated that the teaching content in the lectures and practices did not appear to be integrated. A teacher who had visited Japan emphasized issues based on learning points observed in the Japanese teaching method which connected comparative cultivation trials on rice varieties with lecture contents. These points included observation, measurement of the product's growth and yield components, and report writing relating to the farming practice season by season.

Teacher in charge of Principle of Agronomy in the 9th grade suggested connecting the contents of the lecture and the farming practices with popular local crops such as barley. The field practice could then include a comparison of cultivation among the different varieties of barley. During lectures on germination, for example, the teacher could use the barley cultivation practices to teach the practice of determining germination rate.

Furthermore, the characteristics of plant growth and flowering time could be observed and recorded in the field when the same contents were explained in the lectures. The harvest season could offer the opportunity to observe different maturity timing and to collect yield data for comparisons. The timing of the teaching content in the lectures should thus be matched with the instruction content in the practice activities.

(2) Introducing comparative research:

In the situation at the time of this study, cultivation at school farms was rather limited in offering the experience of farming practices. The teacher in charge of "Industrial Entomology and Mushroom" in the 10th grade also emphasized the necessity of introducing a research context in lectures and practice. The appropriate varieties of mushroom which were easily grown in the school area could be produced in the school farm, allowing for several research topics such as variety comparisons regarding growth and yield. The mushroom beds were available in the agricultural research center in the region and were easy to obtain.

Comparative research could also be introduced to compare apples in different areas. Even if apple trees were not grown in the school farm, the school practice could be conducted on apple farms outside of the school. Teachers and students could visit apple farmers in different areas. The same variety of apple could be collected from different village and the sugar contents of the fruits could be compared.

As a plan for cultivation practices and comparative cultivation trials, the teachers suggested that the school farm be divided into 20 plots for the 9th and 10th grades and another 20 plots for the 11th and 12th grades. In the school farm, crops and vegetables could be cultivated as experimental field practices. Comparative experimental cultivation could provide opportunities for scientific research into different treatments and could also develop knowledge and skills regarding data collection, analysis, and report writing.

It was thus felt that the idea of research should be introduced in lectures and practices. Local products and varieties of each crop, in addition to local cultivation practices, could be used as research targets and prepared for cultivation experiments under the supervision of the agriculture teachers. The experience and knowledge thus gained would later be useful for students, both in higher education and when or if they engage in agriculture.

(3) Learning from farming and processing practices at students' homes and on local farms:
At the time of this study, the families of most students were farmers who cultivated crops, vegetables, and fruits on their own farms or in their home gardens. There were hence many opportunities for students to learn from their own agricultural practices. Additionally, students could learn about natural resources and water management from the real farming practices by local farmers.

Many farmers around the school grew fruit trees, including apple and walnut. The teacher in charge of Principles and Practices of Fruit Crop in the 9th grade suggested that the subject could be linked to the local apple farming and processing which were practiced in the areas around the school and in the neighboring villages. Apples were processed into dry fruit, alcoholic beverages, juice, and jam. It was suggested that these local production processes should be learned through student visits and experienced by the students in the practices in school.

(4) Utilizing the school farm more efficiently and effectively for learning and school management:
The school farm consists of five hectares, including the field and building; however, only one hectare has been used for farming practices since 2014. Thus, the agricultural field could be extended for greater production.

Since apple and walnut are popular as cash crops, it was suggested that the plantations on the school farm be increased for cultivation and research opportunities. These practices could be integrated into the teaching content of the Principles and Practices of Fruit Crop in the 9th grade. Moreover, it was suggested that cauliflower, cabbage, radish, ginger, garlic, onion, and several leaf vegetables be grown as a part of students practice in the school farm. These cultivation practices should then be connected with Vegetable and Medical Plant in the 10th grade and Commercial Vegetable Production and Marketing in the 12th grade.

If apples were to be harvested at the school, agro-processing such as the production of dried apple and apple jam could be practiced in the school kitchen. It was suggested that the learning opportunities arising from existing local processing businesses should be increased by taking students to visit the processers.

More than 20 students who came from the villages or cities far from the school stayed in the school dormitory. The school financially supported the students who stayed at the school dormitory by purchasing food supplies from local markets or farmers. However, it was proposed that if the aforementioned farming activities could be increased, students could produce food for their own consumption. Some harvested and processed products could also be sold in the school or to the local residents. These activities could assist the school management financially, as well as increase learning opportunities regarding farming and business management.

(5) Accumulating the teaching content of lectures and practices:
Since the training and licensing system for teaching agriculture has yet to be established, the subject teachers have not been professionally trained. Most agriculture teachers came from other areas and were not familiar with the farmers' practices and local products grown at an altitude of 2,600 m. The teachers therefore also suggested that each teacher should create teaching notes which could be filed and provided as instructional notes for new teachers. It is important to accumulate teaching knowledge so as to operate efficient schools that incorporate local agriculture.

Relevance of the Results of the Focus Group Discussions

These results identified the issues in agricultural education in the targeted secondary school in Nepal while TVE in secondary school has just been introduced in secondary schools nationwide since 2014. Among five discussion points, the essential issue to be improved is strengthening the links between the educational contents, and regional agriculture and livelihoods with related businesses.

The implementation of the Technical and Vocational Education and Training (TVET) program by Council of TVET has resulted in a low employment rate of graduates largely due to the mismatch between the market needs and program content (ADB, 2015; Bagale, 2018). ADB (2015) argued that the involvement of industry and business is necessary to a market that is responsive in assessing the job market's demand to enhance the employability and productivity of the workforce. Information-

sharing between industry and technical institutions is essential to connect the training content with the necessary skills and knowledge of the targeted businesses to close the gap between educational content and learning outcomes which are far from what the market demands (Nepal, 2015; Bagale, 2018).

In the case of the technical education in agriculture (Plant Science Stream) at the surveyed school, a limited connection of the teaching content with local agricultural practices is recognized as the primary issue as argued by the studies cited above. As the TVET experiences indicate, it is a critical situation with a high risk of mismatching between teaching content and the real need for agricultural development in the region. Also, teaching new agricultural techniques, material, equipment, and economic system without understanding local and traditional farming practices runs the risk of the students uncritically adopting those new technologies which sometimes ruin the natural environment and unexpectedly change the socio-economic situation in the region.

The rural people's knowledge and practices on agriculture and natural resources use have been already appropriate and reasonable in many cases. The traditional livelihoods including farming system in developing countries are generally complex and diversified so that rural people can reduce vulnerability and enhance security and ensure long term well-being and sustainability. These traditional rural practices should be appropriately evaluated and outsiders' and rural people's knowledge could combine their strengths and neutralize the weaknesses (Chambers, 1983; Chambers, 1997).

The main purpose of technical education should be to develop the human capacity to improve or optimize the old practices through obtaining the new information, technologies, business strategies, and even lifestyles without environmental and cultural distraction.

Thus, the learning process from real agricultural practices of local farmers could be fundamental for agricultural education. Comparative research can provide the opportunities to enhance the students' capacity for critical thinking with a verification (evaluation) method on the traditional practices and newly introduced techniques. The farming practices through cultivation experiments and crop–fruit–vegetable production in the school farm can not only give meaningful farming skills and learning opportunities of the regional agricultural practices but also trial practices of new techniques and material including seeds and equipment. Crop–fruit–vegetable production for students' consumption in the school can also provide the experiences of processing, storing, and selling the products which enhances the students' knowledge and skills in agricultural management and business development.

The record of research process and outputs including the collected data and students' reports can be accumulated to utilize as teaching materials and learning references. Kanel (2015) emphasizes the importance of the TVE in secondary schools to enhance capacity development of the teaching staff of technical education. The accumulation of the information through the research and practices in and out of the school can be the teaching contents and manual for the teachers. This practical information can be utilized as effective teaching material during the daily lectures in the classes. Combining the theory and practical information based on real farming practices in the daily lectures can synergistically lead to effective and understandable teaching methods in each agricultural subject.

CONCLUSION

This study identified the existing issues and possible action for the improvement of agricultural education in the surveyed secondary school in Nepal through observations of the Japanese school for comparison and discussions by the teachers with researchers' facilitation. The effectiveness of these ideas should be monitored and evaluated through the implementation of the action plan for the improvements.

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