TRAMLINE TRANSPORT FACILITIES INCREASE THE PRODUCTIVITY OF TEMPERATE VEGETABLE FARMS IN THE UPLANDS OF BENGUET PROVINCE, PHILIPPINES

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ABSTRACT

While the country is endowed with vast agricultural lands, almost half of this is considered as either idle or not very productive. This can be attributed to the mountainous topography that renders transport difficult, labor intensive and costly. The provision of farm-to-market roads (FMR) in these areas is also not an option because the steep slopes make construction of the latter technically difficult and economically nonviable. The uplands thus remain marginalized and low in productivity given its isolation from the market. To address this condition and improve the productivity of these upland farms, the government introduced tramline transport facilities in selected mountainous areas like the Benguet province. Tramlines are hauling facilities that utilize a series of steel cables, pulleys and post structures to transport products from the farms to the nearest roads accessible by vehicle. Tramlines are commonly used for the transport of temperate vegetables like potato (Solanum tuberosum), cabbage (Brassica oleracea), carrot (Daucus carota) and lettuce (Lactuca sativa) which are commercially produced in Benguet Province. The provision of tramline facilities influence the decision of upland farmers in the type of land use, level of input utilization and cropping intensity. Because of the reduction of the cost of transport, farms serviced with tramline facilities apply higher amounts of fertilizer, devote more areas for cropping and have higher cropping intensities resulting in higher productivity. Upland farmers are also relieved from the drudgery of the traditional manual transport.

Key words: mountainous areas, market access, cropping intensity

INTRODUCTION

There is great potential in growing high value temperate fruits and vegetables in the vast uplands in the Philippines. The fertility of these soils, coupled with the cool temperature, make these areas ideal for growing these types of crops that cannot be grown in the lowlands. However, this potential is largely untapped because the terrain in these areas is rugged and largely inaccessible due to the absence of FMR. A report of the European Commission (2005) mentions that more than half of the country’s land area is classified as uplands with slopes exceeding 18 percent. About 8,557,479 has., roughly 28.7 percent of the total land area of the country, are steeply sloping while 6 million has. have 30 to 50 percent slopes and over 2 million has. have slopes greater than 50 percent (De Jesus, undated as mentioned in Idago 2007 ). About 4 million hectares of cultivated lands are already severely eroded and only marginally productive.
According to Ramos (1998), given the lack of FMRs, the most immediate concern for enhancing the productivity of the country’s mountainous regions is to improve their access to the local and regional markets. In these areas, farm produce have to be manually carried on their backs as they traverse the treacherous terrain of the mountainous slopes to the nearest road accessible by vehicle that can transport them to the nearest market centers. The farm inputs are brought up to these upland farms in the same way, manually. With this manual system, the cost of transporting the farm produce to the nearest road ranges from 20 to 30 percent of the value of the produce (Paz, 2003). On the other hand, the cost of transporting production inputs from the nearest road to the production areas ranges from 30 to 50 percent of the cost of inputs, depending on the distance.

The findings of Edmonds (2002) shows that the cost of moving products and inputs between the farm and market significantly affects decisions on farm land use and production decisions such as cropping intensity and application of fertilizers. The higher the transport costs, the less likely that the farms would intensify their cropping as well as utilize greater amounts of production inputs such as fertilizers. This is especially significant during the peak season of harvest and farm operations when farm labor is scarce.

To address this problem, the Department of Agriculture (DA) through the Agriculture and Fishery Modernization Program (AFMP) invested in additional transport infrastructures such as FMR’s and in year 2000 on tramline transport facilities in remote areas that cannot be accessed by road networks. The tramline technology utilizes a series of steel cables, pulleys and post structures to carry products from the farm to the road accessible by vehicle (Fig. 1). The facility is easy to construct since most of its parts use locally available materials.

![Fig. 1. The tramline facility used for hauling production inputs from the road to the production area.](image)

The history of the tramline is very obscure, but apparently the first installation was made in Germany. Countries like Jamaica, Mauritius, Guatemala, Australia utilizes tramline (popularly known as ropeway in some countries) for the transport of agricultural products like fruits (like bananas), cereals (like wheat), and other plantation produce like cotton, tea-leaf or sugar cane. These goods
were mostly transported from the fields to a mill or railway station. Tramlines were in use on sugar plantations for the delivery of canes to the crushing mills (Low Tech Magazine, 2011). In Nepal, where 83 percent of the total land area is covered by mountains and hills, small farmers living in the hilltop and untouched by commercial means of transport and majority of their time and energy is spent on transport, tramline is the most advanced means of transportation (Singh, 2010). With high transportation losses, shortage of young working manpower in the village, migration of young people toward cities, among others, tramlines became an essential infrastructure and was also included in the list of infrastructure projects for climate change mitigation (Adhikary, 2007). In the Alps, people use simple cable-cars to transport supplies and agricultural products to and from remote farms (Mais, 2011).

In the Philippines, tramlines were first used in mining, logging and lately in agriculture. Some of the small-scale mining operations such as the Kias Gold Mine in Benguet used tramlines for ore transport. In logging operations, tramlines were used for wood harvesting. In agriculture, tramlines were used for hauling agricultural commodities such as fruits, bagged grains, vegetables and farm inputs (Dela Cruz et. al, 2000). Tramlines have great advantage over most methods of transportation where products have to be transported over long distances in areas where the topography is extremely rough or slopes are steep. It is also more environment-friendly relative to other access infrastructure such as FMR because the natural physical condition of the area is not altered during its installation. The vegetation need not be cut or cleared as long as the structures are strategically positioned and selected. In Benguet province with its rugged terrain, tramline facilities have been effectively and popularly employed for hauling of production inputs and vegetable produce.

According to Ramos (1998), 70 percent of 137 farmers surveyed in Benguet utilized the tramline facility to haul the requirements of their farms. Although there are limited studies or documentations available about this technology, it is believed that the majority of the tramline facilities in the country today emanated from the Benguet province. Miners and loggers in the province who were displaced from their work because of log bans and closure of mining operations shifted to farming and custom-designed the tramline facility for use in agriculture. From year 2000 to 2004, a total of 15 tramline facilities were installed in selected mountainous areas of the country under the AFMP. In 2007, another batch of tramlines consisting of 12 units worth approximately P15M were also installed.

Idago, et.al (2009) determined the financial and economic viability of installing tramlines in the mountainous areas of the country to transport farm inputs and products. The findings of the study show that while the financial returns to such an investment is not sufficient to make it a viable private investment, the economic returns of 33% are sufficiently high to make it a viable public investment.

This paper discusses the potential of tramlines for enhancing the productivity in the mountainous uplands as they affect land use patterns, cropping intensity and level of fertilizer use in these areas.

RESEARCH METHODOLOGY

Theoretical Framework

The theoretical foundation of the paper is anchored in Von Thunen’s rent theory. Rent theory states that the use of land is a function of the cost of transport to the market and the land rent a farmer can afford to pay. The rent theory highlights the influence of location and transportation cost in influencing spatially explicit economic activities. This is illustrated in Figure 2 showing the relationship of land rent generated by the same piece of land at varying distances from the nearest
market. Production of crops, say crops $i$ and $j$, would yield different amounts of land rent. At distance less than $D_1$, it will be profitable to produce crop $i$ since it will yield higher rent compared to producing crop $j$. At the intersection, crops $i$ and $j$ would yield equal amounts of rent. Beyond the distance of $D_1$ up to distance $D_2$, it is more profitable to produce crop $j$ since it will yield higher rent than crop $i$. Beyond distance $D_2$, neither of the crops $i$ and $j$ would generate any land rent.

Based on this theoretical framework, provision of a tramline facility that lowers the cost of transporting products will have a direct influence on the choice of land use, cropping intensity and level of input use. It is hypothesized that farmers will use the land for the activity that will generate the highest rent (or profit) given the farmgate input and output price.

**Analytical Framework**

The study draws from the works of Edmonds (2002) and Nelson (2001) that recognized socioeconomic and biophysical attributes as the major determinants influencing land use and production decision. Land use, in this paper, is aptly described as the purpose to which the land is committed. Examples of land use would include crop production, pasture, idle/fallow, forest and their relative allocations in a given area. Production decision, on the other hand, refers to the choice by the landowners on the types of crops grown, cropping pattern, cropping intensity, rate of fertilizer application, purpose of production and rate of capitalization. The production system thus can be considered as a function of the land use and production decision.

Without the tramline facility, farmers are limited in terms of the kinds of upland crops that they could grow economically. It is expected that the production system will change with the introduction of the tramline facility that will provide a more efficient mode of transport over the existing manual method of transport.

The area devoted to crop production is expected to increase with the introduction of the tramline facility due to the reduction in the cost of transport of products as shown in equation 1 as follows:

![Fig. 2. Bid rent function of two different agricultural activities at the same piece of land.](image-url)
where:

\[ L_{Uc} = \text{land use for crop production} \]
\[ t = \text{transport cost of products to and from the farm} \]
\[ B = \text{vector of biophysical characteristics} \]
\[ S = \text{vector of socioeconomic characteristics} \]

and \[ \frac{\partial L_{Uc}}{\partial t} < 0 ; \]

Any reduction in the cost of transport increases the level of profit and encourages the increase in the area devoted to crop production. In the same way, the level of fertilizer use also increases with the reduction in the cost of transport and consequent increase in area devoted to crop production. This is shown in equation 2 as follows:

\[ F_U = f(t, p, B, S) \]

where:

\[ F_U = \text{fertilizer utilization} \]
\[ t = \text{transport cost} \]
\[ p = \text{market price of fertilizer} \]
\[ B = \text{vector of biophysical characteristics} \]
\[ S = \text{vector of socioeconomic characteristics} \]

and \[ \frac{\partial F_U}{\partial t} < 0 ; \]

The Study Areas

The study was conducted in the municipalities of Atok and Buguias, the top two vegetable producing municipalities of Benguet that have the most number of tramlines. Atok is a vast farming community located 44 kms. away from Baguio city. It is the top producer of potato (Solanum tuberosum), in the province given its high elevation and cool climatic condition. Buguias is also a vast farming community in the northern part of the province located 88 kms. from Baguio City. It is considered as the top producer of temperate vegetables such as cabbage (Brassica oleracea), carrot (Daucus carota) and lettuce (Lactuca sativa). The province produces 64 percent of the vegetables in the Cordillera Administrative region.

Majority of the tramlines in Benguet were put up with government funding because of the high cost of installation. These facilities are managed and operated by their direct beneficiaries. To sustain its operation, the revenue generated from the toll is used to cover for the cost of operation and maintenance. These facilities are generally located in areas that are intensively cultivated for crop productions but have no access to transport facilities.

Sampling and Selection of Respondents

Cross-section data covering two cropping seasons, the wet and dry seasons, were collected from two groups of farmers:

a. Farmers “without” access to tramline facility referring to remote farms that utilized only manual methods of transport from production to hauling of produce.

b. Farmers “with” access to tramline transport facility referring to remote farms that utilized tramline transport facility for hauling their products.

The respondents for the “with” and “without” scenarios were taken from the same location where all factors such as sociocultural (income, production system, crops planted, etc.) and biophysical (topography, distance, slope, etc.) conditions can be assumed as constant except for their...
access to the tramline facility. A single tramline facility, on the average, serves an effective area of about 7 to 10 hectares and can be adjacent to farms that practice manual transport.

A total of 180 respondents were covered by the study, 90 respondents representing “with” and 90 respondents representing “without” tramline facilities. The respondents were selected through purposive sampling.

**Methods of Analysis**

The study compared two types of remote production areas wherein the only difference characterizing these locations is the presence or absence of tramline described in this paper as the “with” and “without” scenarios. T test was employed to determine if there are significant differences in cropping intensity, land use, rate of inputs utilization and average yield.

**Regression Analysis**

Regression analysis was used to determine the factors influencing the percentage of land used for production, the cropping intensity, rate of input utilization and average yield. It was hypothesized that the presence of the tramline transport facility as well as the percentage of farm irrigated, size of farm, number of family labor, annual household income had positive influences on these dependent variables. In contrast, the distance of farm to nearest road was hypothesized to have a negative influence on these dependent variables because of its effect on transport cost.

**Land use model**

Land use for crop production \((LU)\) is measured as the percentage of total land area that is used for production of crops. Selected socioeconomic (years of farming, annual household income, agriculture-related trainings, numbers of family labor) and biophysical (tramline, farm size, percent farm irrigated) factors are hypothesized to have a significant influence on \(LU\). The land use model is specified as:

\[
LU = \alpha + \beta_1 T + \beta_2 I + \beta_3 D + \beta_4 S + \beta_5 H + \beta_6 tr + \beta_7 L + \mu
\]

where:

- \(LU\) ≈Percent of land used for crop production
- \(\alpha\) ≈constant
- \(T\) ≈ tramline dummy; 1=with; 0= without
- \(I\) ≈ land serviced with irrigation facility, in percent of total area
- \(D\) ≈ distance of farm to nearest farm-to-market road, in meters
- \(S\) ≈ size of farm, in hectares
- \(H\) ≈ total household income per year, in pesos
- \(tr\) ≈ no. of agricultural-related trainings attended
- \(L\) ≈ number of family labor
- \(\mu\) ≈ error term

**Cropping intensity model**

Cropping intensity \((CI)\) is classified as either “intensive” or “less intensive”. “Intensive” is defined as cropping two to three times a year. “Less intensive”, on the other hand is defined as cropping only once a year. A logistic regression model is used given the binary dependent variable that takes a value of either a 1 or 0. The cropping intensity model is specified as

\[
CI = \frac{1}{1 + e^{-b}}
\]
where \( z = \alpha + \beta_1 T + \beta_2 I + \beta_3 s + \beta_4 H + \beta_5 tr + \beta_6 L + \mu \)

\( CI \approx \) cropping intensity dummy;
1 \( \approx \) highly intensive; cropped two to three times a year
0 \( \approx \) less intensive; cropped once a year

**Fertilizer utilization model**

\[ FU = \alpha + \beta_1 T + \beta_2 I + \beta_3 s + \beta_4 H + \beta_5 tr + \beta_6 L + \beta_7 C + \mu \]

where: \( FU \approx \) fertilizer utilization, bags/ha/season @ 50kg/bag
\( C \approx \) cropping season dummy
1 \( \approx \) dry season; 0 \( \approx \) wet season

**RESULTS AND DISCUSSIONS**

**Land Use**

The results of the t-test shows that farms with access to tramline facilities cultivate more areas for crop production because the cost of transport is significantly reduced (Table 1). In the highlands where the average farm holding is very small, each small patch of land is considered very valuable so that given the opportunity, they will tend to maximize the use of these lands for crop production.

In contrast, farmers in hard-to-reach areas that have no access to transport facilities have little motivation to utilize their land for full production because of the drudgery and high cost of moving their products to and from their farms. When market price of the farm produce is very low, farmers would not even attempt to harvest their farm produce because the revenue from sales would not even be sufficient to pay for the transportation cost. The prevailing market price is very crucial for highly perishable temperate crops like cabbage, carrot and Chinese cabbage because these crops cannot be stored. Once these crops reach maturity, these have to be harvested and sold immediately. In contrast, farmers can store potato until they can get a more favorable price.

**Table 1.** Percent land distribution, with and without tramline transport facility, Benguet, 2008.

<table>
<thead>
<tr>
<th>Land use type</th>
<th>With</th>
<th>Without</th>
<th>Mean difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Crop production</td>
<td>84.96</td>
<td>43.48</td>
<td>41.49**</td>
</tr>
<tr>
<td>2. Idle/fallow</td>
<td>1.83</td>
<td>6.85</td>
<td>-5.03*</td>
</tr>
<tr>
<td>3. Forest</td>
<td>8.10</td>
<td>32.58</td>
<td>-24.48**</td>
</tr>
</tbody>
</table>

**Factors Influencing Land Use**

Land use for crop production \((LU)\) is measured in percent of the total land that is used for production of crops. Result of the regression analysis showed that access to a tramline facility has a positive influence on \(LU\) while farm size has a negative influence (Table 2). Access to a tramline facility encourages land utilization for crop production because it reduces cost of hauling the farm produce to the market. On the other hand, farm size has a negative influence on \(LU\) because of the scarcity of farm labor. With most farm operations in the uplands done manually, the area that a farmer can cultivate is limited. The bigger the farm sizes therefore, the smaller the percentage of the area that can be cultivated.
Tramline transport facilities increase the productivity of temperate vegetable farms.....

The other factors such as the years of experience in farming, agriculture related trainings, household income, and other factors did not influence LU. The model is significant given an adjusted $R^2$ value of 0.60.

**Table 2.** Result of the regression model for land use, Benguet, 2008.

<table>
<thead>
<tr>
<th>Predictors</th>
<th>Coefficients</th>
<th>Std. error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-132.94</td>
<td>78.52</td>
</tr>
<tr>
<td>Tramline dummy</td>
<td>50.78***</td>
<td>10.11</td>
</tr>
<tr>
<td>Years of exp in farming</td>
<td>-1.55</td>
<td>2.15</td>
</tr>
<tr>
<td>Annual household income</td>
<td>0.001</td>
<td>0.00</td>
</tr>
<tr>
<td>No. of agricultural trainings</td>
<td>2.37</td>
<td>10.89</td>
</tr>
<tr>
<td>Farm size</td>
<td>-2.83**</td>
<td>1.37</td>
</tr>
<tr>
<td>No. of family labor</td>
<td>5.17</td>
<td>5.97</td>
</tr>
<tr>
<td>Percent farm irrigated</td>
<td>0.05*</td>
<td>0.175</td>
</tr>
</tbody>
</table>

***significant at 1% level of significance  
** significant at 5% level of significance  
*  significant at 10% level of significance  
ns not significant

**Cropping Intensity**

Result of the regression showed that access to a tramline facility has a positive effect on cropping intensity at the 10% level of significance (Table 3). This is also corroborated by the result of the t-test in Table 1 that shows that farms with access to tramline facilities cultivate more areas for crop production. Again, this is because tramline facilities reduce the cost of transport of both farm inputs and products. On the other hand, distance of farm to road has a negative effect on cropping intensity because of the increased cost of transport and the drudgery of moving agricultural products to and from the farm.

**Table 3.** Result of the regression model for cropping intensity, Benguet, 2008.

<table>
<thead>
<tr>
<th>Predictors</th>
<th>Coefficients</th>
<th>Standard error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>1.289</td>
<td>0.93</td>
</tr>
<tr>
<td>Tramline dummy</td>
<td>1.547*</td>
<td>0.91</td>
</tr>
<tr>
<td>Percent farm irrigated</td>
<td>0.036***</td>
<td>0.01</td>
</tr>
<tr>
<td>Distance of farm to road</td>
<td>-1.55</td>
<td>2.15</td>
</tr>
<tr>
<td>Annual household income</td>
<td>0.001 ns</td>
<td>0.00</td>
</tr>
</tbody>
</table>

-2 Log Likelihood= 44.50  
***significant at 1% level of significance  
** significant at 5% level of significance  
*  significant at 10% level of significance  
ns not significant

Access to an irrigation facility has a positive influence on cropping intensity. Without irrigation, farmers cannot plant during the dry months and thus reduces cropping intensity. Annual household income does not have a significant effect on cropping intensity because the average household income is sufficient to finance farm operations and may not pose a significant constraint to intensifying cropping.
Fertilizer Utilization

Organic fertilizer utilization. Results show that the majority of the farms with access to a tramline tend to apply higher levels of organic fertilizer (Table 4). This may be explained by the fact that farmers recognize the advantage of applying organic fertilizers on their farms. However, the transport of organic fertilizers is expensive because it is bulky. The presence therefore of tramlines that reduce the cost of transport encourages farmers to apply the recommended amount of organic fertilizers. On the other hand, those without access to the tramline facility would apply inorganic fertilizer instead because it is less bulky. In the same way, distance of the farm to the market has a negative influence on use of organic fertilizer because of its effect on transport cost.

Table 4. Organic fertilizer utilization of farms “with” and “without” tramline transport facility for wet and dry seasons, Benguet, 2008.

<table>
<thead>
<tr>
<th>Crops</th>
<th>Bags ha(^{-1}) season(^{-1})</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>“With”</td>
<td>“Without”</td>
</tr>
<tr>
<td>1. Potato</td>
<td>Wet</td>
<td>191.65</td>
</tr>
<tr>
<td></td>
<td>Dry</td>
<td>184.45</td>
</tr>
<tr>
<td>2. Cabbage</td>
<td>Wet</td>
<td>245.47</td>
</tr>
<tr>
<td></td>
<td>Dry</td>
<td>238.75</td>
</tr>
<tr>
<td>3. Carrot</td>
<td>Wet</td>
<td>161.44</td>
</tr>
<tr>
<td></td>
<td>Dry</td>
<td>145.3</td>
</tr>
<tr>
<td>4. Chinese cabbage</td>
<td>Wet</td>
<td>227.38</td>
</tr>
<tr>
<td></td>
<td>Dry</td>
<td>172.58</td>
</tr>
</tbody>
</table>

** significant at 1% level of significance
* significant at 5% level of significance          \(^\text{ns}\) - not significant at 5% level

Factors such as the size of family labor, access to farm irrigation and household income have a significant influence on the application of organic fertilizer for some crops as shown in Table 5. Available family labor is important because it provides more work force to haul and apply fertilizer. The higher household income would also allow farmers to afford the cost of fertilizer.

The other predictors like household income, trainings attended, years of experience in farming, farm size, percent farm irrigated, number of family labor and cropping season did not have a significant influence on fertilizer utilization. Simply knowing that the application of fertilizer will increase productivity is not as important as the relative cost of transporting the inputs and products in or out of the area. The cost of transport and the drudgery seems to have greater influence in their decision to apply fertilizer. Hence, the presence of the tramline facility and distance of farm to road were significant factors affecting fertilizer utilization.

Inorganic fertilizer. Farmers apply a significant amount of inorganic fertilizer only on chayote and Chinese cabbage in areas serviced by tramline facility (Table 6). On the other hand, the amount of inorganic fertilizer applied to the other crops is minimal so that there is no significant difference in inorganic utilization between those farms with access and no access to tramline facilities. The small amount of inorganic fertilizer requirement can easily be manually transported to the farms.
Tramline transport facilities increase the productivity of temperate vegetable farms.....

Table 5. Factors affecting organic fertilizer utilization for various crops, Benguet, 2008.

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Potato</th>
<th>Cabbage</th>
<th>Carrot</th>
<th>Chayote</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>101.7**</td>
<td>171.0***</td>
<td>108.4***</td>
<td>82.92**</td>
</tr>
<tr>
<td>Tramline dummy</td>
<td>100.6***</td>
<td>62.09*</td>
<td>27.37</td>
<td>61.66***</td>
</tr>
<tr>
<td>Years in farming</td>
<td>1.0E-3</td>
<td>-2.0E-3</td>
<td>1.0E-4</td>
<td>-0.04</td>
</tr>
<tr>
<td>Household income</td>
<td>1.0E-3</td>
<td>2.0E-5</td>
<td>0.001</td>
<td>0.01</td>
</tr>
<tr>
<td>Trainings attended</td>
<td>-7.44</td>
<td>-1.48</td>
<td>-14.40*</td>
<td>-10.82</td>
</tr>
<tr>
<td>Farm size</td>
<td>3.98</td>
<td>12.11</td>
<td>2.98</td>
<td>2.11</td>
</tr>
<tr>
<td>Irrigation</td>
<td>-0.74**</td>
<td>0.35</td>
<td>0.11</td>
<td>-0.27</td>
</tr>
<tr>
<td>Distance of farm to road</td>
<td>-0.5**</td>
<td>-0.06*</td>
<td>-0.03**</td>
<td>-0.05**</td>
</tr>
<tr>
<td>Family labor</td>
<td>19.46***</td>
<td>-1.14</td>
<td>2.45</td>
<td>5.43</td>
</tr>
<tr>
<td>Cropping season</td>
<td>-1.46</td>
<td>-22.53</td>
<td>-5.89</td>
<td></td>
</tr>
</tbody>
</table>

Notes: Chayote has no cropping season dummy because it is an annual crop.
*** significant at 1% level of significance
**  significant at 5% level of significance
*   significant at 10% level of significance

Table 6. Inorganic fertilizer application of farms “with” and “without” tramline transport facility for wet and dry season, Benguet, 2008.

<table>
<thead>
<tr>
<th>Crops</th>
<th>Bags ha⁻¹ season⁻¹</th>
<th>Mean difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>“With”</td>
<td>“Without”</td>
</tr>
<tr>
<td>1. Potato</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wet</td>
<td>11.67</td>
<td>10.21</td>
</tr>
<tr>
<td>Dry</td>
<td>13.37</td>
<td>12.73</td>
</tr>
<tr>
<td>2. Cabbage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wet</td>
<td>15.77</td>
<td>11.35</td>
</tr>
<tr>
<td>Dry</td>
<td>14.67</td>
<td>11.62</td>
</tr>
<tr>
<td>3. Carrot</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wet</td>
<td>9.06</td>
<td>8.92</td>
</tr>
<tr>
<td>Dry</td>
<td>14.15</td>
<td>8.53</td>
</tr>
<tr>
<td>4. Chinese cabbage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wet</td>
<td>25.61</td>
<td>10.40</td>
</tr>
<tr>
<td>Dry</td>
<td>22.67</td>
<td>8.50</td>
</tr>
<tr>
<td>5. Chayote</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>27.30</td>
<td>19.89</td>
</tr>
</tbody>
</table>

** significant at 1% level of significance
*   significant at 5% level of significance
ns – not significant at 5 % level of significance

Results show that the presence of the tramline facility does not have a significant influence on the application of inorganic fertilizer (Table 7). This is because inorganic fertilizer is not commonly applied in the small farm plots in the area.
Table 7. Factors influencing inorganic fertilizer application for various crops, Benguet, 2008.

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Potato</th>
<th>Cabbage</th>
<th>Carrot</th>
<th>Chayote</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>22.84</td>
<td>-0.90</td>
<td>5.34</td>
<td>18.35***</td>
</tr>
<tr>
<td>Tramline dummy</td>
<td>6.32</td>
<td>-0.81</td>
<td>6.16</td>
<td>6.98</td>
</tr>
<tr>
<td>Years in farming</td>
<td>-4.0E-3</td>
<td>-1.0E-3</td>
<td>-9.6E-5</td>
<td>0.33</td>
</tr>
<tr>
<td>Household income</td>
<td>2.0E-5</td>
<td>3.7E-5</td>
<td>2.7E-5</td>
<td>7.7E-5</td>
</tr>
<tr>
<td>Trainings attended</td>
<td>-4.74</td>
<td>3.96*</td>
<td>-0.46</td>
<td>-2.04</td>
</tr>
<tr>
<td>Farm size</td>
<td>-0.08</td>
<td>-0.01</td>
<td>0.01</td>
<td>-0.01</td>
</tr>
<tr>
<td>Irrigation</td>
<td>-4.0E-3</td>
<td>0.01</td>
<td>-5.0E-3</td>
<td>0.01</td>
</tr>
<tr>
<td>Distance of farm to road</td>
<td>-0.48</td>
<td>-0.26</td>
<td>0.45</td>
<td>-1.57</td>
</tr>
<tr>
<td>Family labor</td>
<td>-0.90</td>
<td>-0.43</td>
<td>2.17</td>
<td>=</td>
</tr>
</tbody>
</table>

Notes: Chayote has no cropping season dummy because it is an annual crop.
***significant at 1% level of significance
** significant at 5% level of significance
* significant at 10% level of significance

Influence of Tramline Facility on Crop Yield

The results in Table 8 shows that access to the tramline facility has a significant influence on yield of crops such as potato, carrot, cabbage and Chinese cabbage that are normally applied with organic fertilizer. The reduced cost of hauling provides an incentive for farmers to apply more organic fertilizer that result in higher productivity. In contrast, the amount of organic fertilizer applied to chayote is minimal compared to the above-mentioned crops so that access to the facility does not have a significant effect on productivity.

Table 8. Average yield of crops in farms “with” and “without” tramline facility, Benguet, 2008.

<table>
<thead>
<tr>
<th>Crops</th>
<th>Yield, kg per season</th>
<th>Mean difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>“With”</td>
<td>“Without”</td>
</tr>
<tr>
<td>1. Potato</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wet</td>
<td>17,389.53</td>
<td>9,194.36</td>
</tr>
<tr>
<td>Dry</td>
<td>18,456.86</td>
<td>10,516.92</td>
</tr>
<tr>
<td>2. Cabbage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wet</td>
<td>27,276.60</td>
<td>22,034.52</td>
</tr>
<tr>
<td>Dry</td>
<td>26,348.09</td>
<td>16,524.44</td>
</tr>
<tr>
<td>3. Carrot</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wet</td>
<td>18,243.25</td>
<td>9,465.06</td>
</tr>
<tr>
<td>Dry</td>
<td>18,350.41</td>
<td>10,503.48</td>
</tr>
<tr>
<td>4. Chinese cabbage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wet</td>
<td>33,983.33</td>
<td>12,738.18</td>
</tr>
<tr>
<td>Dry</td>
<td>32,496.29</td>
<td>16,563.33</td>
</tr>
<tr>
<td>5. Chayote</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wet</td>
<td>57,190.58</td>
<td>55,609.45</td>
</tr>
</tbody>
</table>

** significant at 1% level of significance
* significant at 5% level of significance
ns – not significant at 5 % level of significance
CONCLUSION

The provision of tramline transport facility in the remote uplands has a strong influence on the type and intensity of land utilization. Farms with access to the tramline facility tend to be more intensively cultivated because of the ease of transporting farm inputs and products. In addition, the availability of irrigation water also influences cropping intensity.

The presence of a tramline facility has a positive influence also on the rate of use of organic fertilizer. In the uplands, more organic fertilizer is applied relative to inorganic fertilizer. However, organic fertilizer is bulky making its transport more costly and difficult because of the scarcity of manual labor. Tramline facilities reduce the cost of transporting farm inputs such as fertilizers into their farms.

All of these findings collectively support the contention that provision of tramline transport facility in the remote uplands, not serviceable by FMR, is an effective and practical approach to increase productivity of the upland farms and enhance the utilization of the vast upland resources.

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REFERENCES


