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Abstract

A new design of three-wheeled vehicles has evolved in Crete, Greece, to serve the needs of the agricultural sector. The vehicle appears to have been in part responsible for the economic revival of agriculture in Crete. The three-wheelers borrowed much of their early technology from two-wheeled rototillers but quickly evolved into a unique vehicle. The rapidity of development suggests a largely unfulfilled need for rural transport in less developed countries. The three-wheelers have also been responsible for an improved quality of life in the rural areas.

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An interesting new class of vehicles is being developed on the Greek island of Crete to serve its rural personal and small-scale transport needs.* These are three-wheeled vehicles in a variety of sizes and designs. It appears that these vehicles are, in a large part, responsible for the economic revival of rural Crete. The extent to which improved small-scale rural transport affects the socioeconomic structures in less developed countries is rarely perceived. Crete thus provides an unusual example of improved rural transport. Furthermore, similar types of vehicles, sometimes imported from Greece, are now appearing in other less developed countries. Conceivably, the Cretan experience will help us anticipate some of the effects of improved rural small-scale transport in those countries.

What are the effects of improved small-scale rural transport? Improved transport offers both faster movement and the ability to carry greater amounts of goods. Compared to walking, virtually every vehicle, from a bicycle on, can reduce the time devoted to transporting a person from one place to another. Most rural areas, and Crete in particular, consist of small, densely populated villages surrounded by farming areas. This means that a farmer must walk several kilometers each day between his home and fields. Higher speed movement, using a bicycle, moped, motorcycle or small vehicle, cuts travel time and creates additional productive time.

At the risk of sounding like a time and motion study, we can estimate the potential increase in productivity through better

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*Please see illustrations at end of paper.

transportation. Assuming that the farmer must walk 6 km each day, about an hour would be spent traveling. Driving a moped, the farmer could cover the same distance in about a quarter of the time, which would free about 3/4 hour each day, adding perhaps 8-10% available working time. Thus, a relatively simple improvement in personal rural transport could potentially increase output 5-10%. The improved ability to transport goods could affect productive potential in a similar fashion, although it would depend very much on the type of agriculture. In addition to increasing output through acceleration of traditional agricultural techniques, improved transport also permits increased output through technological innovations. The increased opportunities brought on by transport-induced technological change are extremely difficult to estimate. Conceivably, a vehicle that improves the movement of a farmer's personal and marketable goods could increase productive potential anywhere from five to fifty percent.

A vehicle also introduces liabilities. A farmer may be forced to devote a part of the spare time created by the vehicle to maintaining it. Some of the worker's time must also now be allocated to paying for the vehicle. This financial burden may divert the farmer's energies and spare time into other income-producing activities.

Even if the net effect of improved transportation on spare time is negligible, other factors make owning a better vehicle especially attractive. A cinema operator in Iraklion, for example, observed a substantial increase of patrons from the villages. The three-wheelers parked next to the cinema every evening confirmed this observation. For the farmers of Crete higher quality of life means spending more

time at the local taverns with the other farmers (where previously the time would have been spent walking home), visiting nearby relatives or taking someone to the doctor during the harvest season where previously the day-long bus trip (because the connections are so poor) took too much valuable time. A motor vehicle of any kind has status. The quality of life is perceived by many to have been raised through the acquisition of a vehicle simply because it imparts status.

Until recently there were relatively few motorized agricultural implements in Crete. Perhaps the most common item within this small group was the two-wheeled rototiller, such as the German HAKO-WERKE. A 6-8 hp petrol engine powered the two wheels and any attachments. The farmer controlled and steered the rototiller with hand controls mounted on extensions from the chassis. A two-wheeled cart was one attachment. The farmer could transport some goods or a few passengers while he sat in the cart, driving the vehicle via the hand controls.

For the few farmers that could afford these rototillers, large increases in productivity were achieved. The work of one man tilling with a machine could equal that of ten laborers (and vineyards must be tilled twice each year). The small cart could carry more grapes or olives than a mule and perhaps a little faster, although they had to be hand carried to the nearest navigable track. As a vehicle, the cart and engine was hardly a speedster. On an open paved road it could go no faster than 25 km/hr and on a path not much faster than a brisk walk.

Quite suddenly in the late 1960's, the situation changed. Mechanization became much more widespread and locally manufactured vehicles began to appear. The forces behind this transformation are not clear. Several factors may have played a role. One may have been an increasing shortage of agricultural labor. The villages, in a long economic decline as the young men sought better jobs elsewhere, could not supply the manpower needed to support the traditional labor-intensive methods of cultivation. As a result, farmland was either abandoned or brought under mechanized cultivation. A vigorous government roads program ensured year-round connections with the coastal cities. The roads permitted the delivery of necessities of mechanized agriculture; at the same time, the roads stimulated new desires and demands for transport. During this time, technological and mechanical expertise began to develop both through the construction of new equipment and the repair of older equipment. Moreover, the people of Crete have always prized their independence and self-sufficiency. This was reflected in the support facilities, such as machine shops, which were far more sophisticated than would be expected for a region of Crete's size (about one half million population).

In that period, several factories in Crete began manufacturing the two-wheeled rototillers, with much of the financing coming through the Agricultural Bank of Greece. Many parts were imported but the design soon become uniquely Cretan.

In the early 1970's the pace quickened. In addition, an entirely new vehicle appeared. This was a true three-wheeler. Instead of the engine driving the two front wheels with a flexible link to the

cart, the engine rested on a rigid chassis driving the rear wheels, with a gear and drive shaft system replacing the belt drive. The multi-purpose character was maintained, however, because only 3 bolts fixed the engine to the chassis. In less than half an hour, the engine could be transferred to a rototiller.

Three-wheelers are not new to Greece. They are familiar sights in the urban areas. Homemade three-wheelers have been used for over thirty years. These were typically converted BMW motorcycles with side-cars. The more sophisticated designs mated the motorcycle's drive system with a two-wheel cart. Other three-wheelers were imported from Italy and later manufactured in Greece. In the latter type, the driver steered the single front wheel while the freight bed lay behind him over the two rear wheels. These three-wheelers are still very popular for small-scale commercial transport. In Greece, as in many European countries, license fees are based on engine size. Thus, to avoid a substantial increase in license fees, these three-wheelers had engines smaller than 50 cc. Partly due to their limited power, these three-wheelers never caught on in the rural areas. Also, the license fees for agricultural vehicles were much lower than non-agricultural vehicles; the incentive for 49.9 cc agricultural vehicles did not exist.

The appearance of the agricultural three-wheeler coincided with the sharp rise in oil prices. It may merely have been a coincidence, although the economics would suggest otherwise. Gasoline prices in Greece are among the highest in the world, $0.60/liter- about three times U.S. prices. Diesel oil prices, however, are about a third

that of gasoline ($0.21/liter). Most of the rototillers, such as those used to pull carts, were gasoline-powered. With diesel oil costing only a third as much, there was certainly a strong economic incentive to use diesel engines whenever possible. Few other countries used such a lopsided fuel pricing policy, hence, nobody had tried to build small (8-12 hp) diesel vehicles. The Cretans may be the first to do so on a large scale.

By the summer of 1977, the agricultural three-wheeler had come of age. At present, about 20 factories in Crete were building three-wheelers. The largest plants were building about 1500 vehicles/year while the smaller ones, some in shops smaller than 150 square meters, apeared to be building about one hundred vehicles/year. Current statistics are not available, but it is estimated that about ten thousand of these three-wheelers have already come into use since their appearance some four years ago. Total annual production must be around several thousand vehicles each year.

The three-wheeler's design has become standardized to the extent that it is a recognizable vehicle even though 20 unrelated factories are building it. Most of the vehicles use an 8 or 12 hp rope-started diesel engine. The power from the forward-positioned engine is transmitted through two independent gearshifts to the rear wheels. The automobile-strength rear axle can typically support a 1000 kg payload. Maximum speed is 40-45 km/hr. One manufacturer claimed operating costs were 1.5¢/km or 21¢/hour (based on Greek fuel prices). New vehicles cost about $2,500.

How are the three-wheelers used? This depends upon the season. In the late summer (when I was there) the activities centered around the grape harvest. Thus, many three-wheelers were seen carrying baskets of grapes to local presses and drying areas. Occasionally they would carry support materials, such as polyethylene sheets (which are used to accelerate raisin production) and extra baskets. But harvesting grapes is very labor-intensive. More than anything else, the three-wheelers carried people. The three-wheelers could easily carry six people and often carry up to nine on trips to the city without any adaptation. (This suggests that the vehicle has great potential as a rural minibus.) In other instances, the three-wheelers carried feed, a few goats, firewood, and insecticide.

In other seasons, farmers till and plow the fields. The engine must be removed from the three-wheeler and connected to the tiller. This will probably occur less frequently in the future since many of the newer three-wheelers have permanently attached engines.

A spectrum of transport alternatives seems to have developed. At the lower end is the cart pulled by the rototiller. It has limited speed and capacity but is obviously the cheapest alternative. Here the overriding requirement is for a mechanized agricultural implement with transport being almost incidential. The three-wheeler comes next, providing greater speed and capacity. The models with a removable engine still provide motive power for cultivation, but the fixed engine designs are only for transport. At the top is the group of light pickup trucks which offer even higher speeds and slightly more capacity as well as much greater personal comfort. A light pickup costs about

$6,000 in Crete. These pickups use gasoline engines so their operating costs are much greater than the three-wheelers. The choice of vehicles depends upon the size of the farm, the farmer's income, and his perceptions of status.

Without any planning, a motor vehicle industry is developing in Crete. Many of the three-wheelers presently being built are sophisticated vehicles. Some have enclosed driver's compartment, electric ignition and turn signals. At least one firm plans to build a four-wheeler! While few of the three-wheelers are seen on mainland Greece, they are already being exported to nearby countries. Some manufacturers are talking of a manufacturers' association, but none had been formed as of summer 1977.

Besides the creation of a unique vehicle, the evolution of the three-wheelers indicates the importance of transport in agricultural areas of less developed countries. Starting with what was essentially an attachment to a mechanized farm implement, a vehicle emerged for which the implement became secondary, and eventually entirely dissociated. The rapidity with which this demand was realized and met--less than a decade in Crete--indicates the importance and potential of improved rural transport.

CBB 779-9020

1. A rototiller and cart. The man on the left is starting the engine. The cart is full of grapes and other goods. Three adults and a child will ride on top of the cargo. Note how the woman in the center is steadying the rototiller and depressing the brake pedal.

   The grapes were hand-carried in baskets from their fields some 50 meters above the vehicle. They will now drive the few kilometers to their village to unload their grapes and take a siesta.

CBB 779-9014

2. An urban three-wheeler. This type of vehicle proved not to be rugged enough for rural use. Nevertheless, they are used extensively within the cities for small goods transport. Similar chassis have been used for taxicabs in southeast Asia.

CBB 779-9004

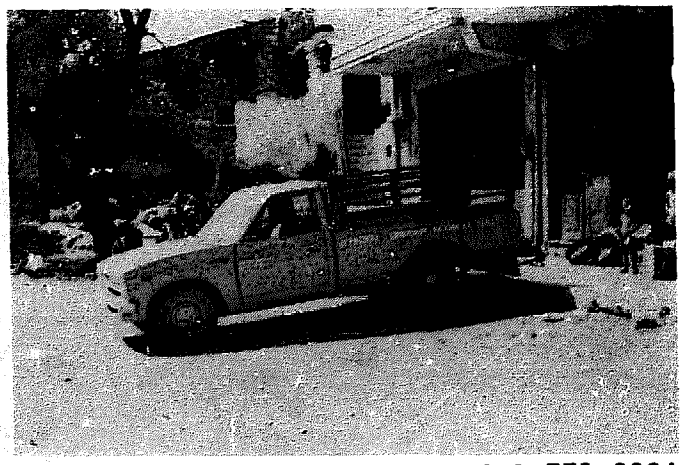
3. A three-wheeler carrying hay. This design is fairly early on the evolutionary scale. The engine can be removed for use on a rototiller. The front wheel is smaller than the rear wheels and the driver steers with a handle, rather than a steering wheel, and uses hand controls rather than foot pedals.

CBB 779-9022

4. A side view of a three-wheeler. Here a farmer is loading cuttings in the vehicle, possibly to feed goats at home. He is also carrying a large insecticide apparatus (behind the clippings). This design is slightly more sophisticated. The drive-shaft, as well as the steering linkage, is faintly visible beneath the floor. Note the single headlight. The engine is still removable.

5. An advanced design three-wheeler. The driver's compartment is now partially enclosed and the engine is covered. There are two headlights and the newest have internationally specified (probably imported) turn/brake lights on the rear.

CBB 779-9006



CBB 779-9024

6. A light pickup truck. For larger loads and longer distances, pickups are very popular.

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