

# **The Eco-Design and Development of Farmers Working Vehicles and Their Tractors - History and Innovation**

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## **ABSTRACT**

25 million farmers drive old, primitive tractors and also new tractors which, from an auto-technology standpoint use technology of much lower standards than other vehicles.

The quest for improvement and the recent significance of ECO-DESIGN, (due to fuel-price rises) in cars, trucks, buses and SUVs has obscured the absence of the use of modern automotive technology in farmers working vehicles.

In India, the gulf between the technology of farm tractors and that of other vehicles has become an ever-widening chasm.

Eco-Design considerations now demand that automotive-engineers begin to consider tractors, farm vehicles, trailers and ag-implements as a whole and not as now piecemeal.

## **BACKGROUND AND HISTORY**

Most people know about Jeeps, Land-Rovers, Ox-Carts and farm tractor-trailer combinations that perform such useful transport-work throughout the world.

In the period since 1950 many new specialised vehicles have been created such as the Unimog, the Range-Rover, the Stonefield, AKO (Australia) and its Indian version RTV, the Corneuil from France and lots of Jeeps in the Philippines. At least as important are the many different farm tractors like the Bell-Hauler from South Africa, the M.B. Trac, Intrac and XYLON from Germany, the general-purpose tractor called the Trantor tractor, the Agricultural Land Rover, (Agrover) and Forest- Rover from U.K. Also there are many kinds of farm-spraying vehicles (self-propelled sprayers) such as Berthoud from France and the Agri-buggy, Clayton, Chavtrac, Chafer, Bateman, Househam from U.K.

Some of these special-vehicles were built originally from tractors or vehicles of the Land-Rover kind.

In China, Rural Transport Vehicles (RTV's) of many kinds are found in a variety of specifications and quality. In India, the Rhino, the Mahindra Jeep, the Tata 207, Tata Safari and the Hindustan Tempo and many others have been created since 1980 and most with little recent design participation from Europe.

There are about 25 million daily-users of farm tractors in the world and much of the work of these tractors is in transport. Whilst all these tractors have 3 point linkage, power-take-off (pto) and hitches for trailer-pulling, there are few if any rural farm vehicles of the Land-Rover kind that have 3 point linkages and power take offs (pto's) and there are even fewer that have a hitch for haulage of trailers of a 4 ton plus size.

## **WHEEL CONFIGURATION AND DRIVING POSITION:**

There are very few new concepts in the world of modern tractors and farm vehicles largely due to the continuing and general acceptance of slow conventional ploughing-first tractors, with their large rear wheels and tyres and smaller front ones. Whilst most recent new concepts in tractors have 4 equal-wheels (Unimog, M.B. Trac, Xerion and Fastrac) so has the Land Rover. The Land Rover used to have a small power take off, and a simple 3 point linkage and the early Land Rover prototypes even had their driver positioned in the conventional tractor position, which was also the preference of Intrac, MBTrac, Trantor, Fastrac and Xerion, all of whom consider the central driving position (of conventional tractors) as significant. It is reasonable to deduce that farming practice demands this central position whereas transportation by Unimog, Land Rover and Mercedes G-Wagons represent something different, hence left or right hand drive.



**Figure 1** : Unimog in Multi –Operation Fieldwork Mode

The only exceptions to the rule of having equal wheels on new tractor concepts were the early Deutz Intrac, the Trantor and the Fendt-Xylon created by the Fendt family in Germany. These 4 new kinds of farm vehicle cum tractor have larger rear wheels than those to the front but the overall size ratio is much smaller on Xylon than on the others. The Trantor tractor is quite different to all other vehicle concepts because the designs were originally focused towards on-road and off-road transport by farm trailers of a kind found in Britain, France and on most farm estates overseas - the unbalanced trailer. Germany, for some reason best known to them, sometimes use trailers with a wheel at each corner, called balanced trailers. In USA too, the bin-type trailers are often balanced. The presence of a particular kind and size of trailer is a significant transport-related design feature and one, which is very important indeed to farm management in a worldwide context. It has governed the thinking of the most revolutionary of those designers who have created vehicles for overseas farm situations (such as palm-oil and sugar estates abroad, and potato and sugar beet growers in France and U.K.) where haulage by trailer is often over long distances, on poor, wet roads and wet tracks.

The Fendt Xylon design objective, and its GTA Systems tractor forerunner was directed to combining three or more in-field work tasks at one pass over and through the soil, largely because German farmers were interested in these “combined” systems. British and French farmers now seem to be following the lead of their German counterparts.

#### **FARM TRACTOR PLATFORM SIZE AND PERSONNEL CARRYING**

The Fendt-Xylon was designed as a slow, 40 km/h Systems Tractor. The Fastrac and the Unimog were designed to operate at 80 km/h (50 mph) and both have a spreading and spraying platform, at the rear. The MB Trac was designed as a 40 kph tractor with a bigger platform than the Fastrac but a smaller one than the faster Unimog. Like the Xylon, which has a front platform the Xerion from Claas is altogether much

bigger and provides the option of front and rear platforms.

Of course, conventional tractors have a wider range of difference between rear and front wheel size than the Xylon (nearly equal wheels) but MB Trac, Unimog and Fastrac have equal wheels. Front linkage and frontal equipment are clearly perceived as more important to the concept of Xylon by its design team.

The priority given to additional transport-related features, such as passenger-carrying and implement-carrying between fields has been present since 1972 in all of the Trantor tractors [1] built to date. The presence of 3 seats in the cabin frame and up to 5 in the pick-up-style back (sometimes with canvas roof for India, Yemen, and Africa) is a key feature, if a secondary one, in the “Trantor rural work vehicle” concept. The size of the rear platform of the Series 2 Trantor prototype was smaller than Fastrac, MB Trac and Unimog. The relatively large size of the unequal wheels of conventional tractors, compared to the rural Trantor vehicle, relate more to the expectation that the convention must be able to conduct primary cultivation (deep ploughing and sub-soiling) under wet conditions. The Trantor vehicle however requires to disc plough and cultivate with discs in drylands and wet fields but it is expected to work for at least twice as long (in hours used) in a farming year!! This is because Rural Transport work vehicles are expected to operate alongside and to complement ploughing-first tractors of the wheeled or tracked type, rather than replace all of them!

#### **CONVENTIONAL PLOUGHING-FIRST TRACTORS**

1990’s developments have focused on marginally increasing the speed of tractors, which, many years ago were deliberately designed to travel slowly! The increase from 32 to 40 km/h (20 to 25 miles per hour) by adding the odd gear to facilitate slightly increased speeds on smooth, flat roads, and not at all on rough tracks and fields, was the finishing point reached by the mainstream tractor makers by the end of the 20th century. The second innovative movement of an incremental type was the addition of a simple form of suspension on front axles.

These financially constrained and blinkered ploughing-first, incremental design additions of Fiat-CNH, John Deere and Agco (Massey Ferguson), Same-Deutz, Valtra, Landini - McCormick and Class-Renault, which have continued for some years, now seem to be challenged by the daring, high-investment -levels of JCB’s Fastrac development. As a result of JCB investment, the mainstream has now created a strategy of “something has to be done quickly”, qualified as, “

we are a bit busy and cash-stripped so are unable to concentrate properly on it just yet!"

The European Commission, with strong German support, has taken notice that Agco-Fendt's 50 km per hour, on-road performance is illegal in most European countries and especially in Britain and France - markets that Fendt would like to have been stronger in. The Agco-Fendt tractor is, of course, a real conventional tractor and Fendt have been using a real tractor front suspension for some years - whereas competitors have only begun to catch up in recent years.

### **INFLUENCES OF INCREASING TRACTOR SPEEDS**

Agco-Fendt's advertising in Britain (and France) presented the market with a conventional tractor that could travel on the road at 50km/h, (when the legal road speed, for conventional tractors like Fendts was 32km/h). This advertising was clearly aimed at explaining that the product could travel faster than normal tractors but was NOT in the same league as Fastrac, Trantor and Unimog, which could (with their C&U regulation-approved specification) travel LEGALLY at 80 km/h (50 miles per hour). All of these 80km/h 'vehicles' can operate as versatile off-road vehicles and in-field, because of having rear axle suspension in addition to a properly-specified suspended front axle to achieve adequate in-field manoeuvrability!! Whilst Mercedes-Benz were the first to recognise the importance of increasing tractor productivity, by increasing speeds, and they developed their Unimog into a serious farm tractor, it was the UK-based Trantor tractor team in the Faculty of Technology of Manchester University, however, that first considered that a Land-Rover and tractor combined could make good commercial sense to farmers, who understood that large amounts of farm management time is devoted to materials handling and transportation. In Germany, the R&D work of all German tractor manufacturers was simply trying to cause the bigger and heavier ploughing-first tractors to go faster, firstly to 40 km/h and thence (at Fendt) to 50 km/h.

### **DEVELOPMENT CONCEPTS**

There is not and has not ever been a new conceptual change in approach within the mainstream, multi-national tractor manufacturers (Fendt were small when introducing Xylon as were Deutz when introducing the Intrac), all of whom have adopted an incremental tractor development policy and one that had little, and not any proper statistical analyses of tractor usage time with implements, trailers etc., i.e fundamental work study as part of farm management! [2]. Whilst the vision of Deutz and Fendt was limited and mainly directed to German operations rather than worldwide-farming, the detailed

engineering budget for investment was consistently good.

There are few publications from France, Italy or U.K. dealing with concepts of tractors and the comparison between them but the new FP7 European Community (EC) proposals concerned with lowering diesel fuel consumption of tractors, improvement of productivity and reduction in soil-compaction are certainly well thought through as objectives. The perspective of [www.manufuture.org](http://www.manufuture.org) is also a clear policy statement of essential change for the better.

The Corneuil, the Land Rover, the Subaru, the Daihatsu pick-ups and the Mercedes G Wagon are well-known and sufficiently well-established in farming to be considered as useful farm vehicles and they recognise passenger-carrying in the cab and on the rear platform. It is common practice for work teams to operate with tractors, implements and trailers on all sorts of farm work and this is recognised in many international situations which cause the gang (team) and the tractor and implement to be the working system with the pick-up truck (Land Rover, Subaru etc.) simply waiting to take the team back to base. Each of these vehicles and the tractors mentioned above concentrate on carrying weight, not pulling it.

The significance of Land Rover in farming is not so much that it was successful at in-field cultivation, but rather that its presence has led onto "other vehicle developments" in the spraying and spreading areas of farming with early UK-designed Chavtracs and Frasier Agribuggies for example! Not only this but the special products division of Land Rover did a lot of development work and some of it similar to Fendt's work in 1971 (Agrobil).

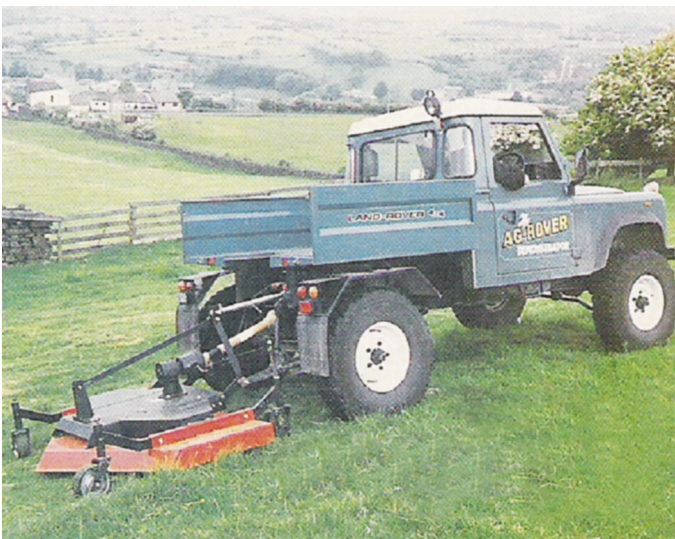
### **THE LAND ROVER FARM VEHICLES**

The Land Rovers (launched at Amsterdam Show 30.4.1948) were directed towards farmers. They were supposed to be designed and developed for real farm work so that when the independent Rover Company decided what its design brief should be they began, "to design a vehicle rather similar to a Willys Jeep - even more useful to the farmer; a proper farm machine, not just a another jeep..... much more versatile....., much more use as a power source....., able to drive things....., to have power take-offs everywhere....., and to have all sorts of bolt-on accessories, to be used instead of a tractor at times.....to be able to do everything!"

Any person reviewing the Chinese Rural Transport Vehicle sector or reviewing the Indian tractor and jeep market will immediately see the significance of yesterday's Land Rover work to the requirements of



**Figure 2** : A Typical Early Land - Rover



**Figure 3** : Aggrover with 3-point Linkage + PTO+ hi Clearance Axle

rural India and rural China. In to-day's world, the Jeep has been replaced by 4x4 pick up trucks (Subaru, Toyota Hi-Lux, Tata - 207, Ford, Peugeot, and many others) and by 4x4 people carriers (Toyota Land Cruiser, Ford Bronco, Tata-Sumo, Shogun, Range Rover and others). The development of the Land Rover has moved away from its rural origins to become an urban people carrier and occasional horse-trailer-puller in the countryside!

### **THE CENTRAL DRIVING POSITION OF LAND ROVER PROTOTYPES**

Ken and Julie Slavin's 4th edition of their Land Rover book is an interesting and well-researched review of Land Rover's history. It shows, on Page 36, a photograph of the Land Rover 1947 prototype with central driving position (driver in the middle not to one side) and no doors. (see also [www.lr-mad.co.uk/](http://www.lr-mad.co.uk/)

Trantor.html). Land Rover was originally intended to be a farmers work and transport vehicle. As Autocar magazine reported in 1948, "Land Rover is a mobile power station, will tow or do a variety of useful work on the land over rough ground. It can drive a large circular saw and cut up timber for firewood. It can be used with trailers to transport loads over ploughed fields or other hard going. As a mobile power source it takes the power to the job. Through the power take off, it can be harnessed to drive a threshing machine, an elevator or a chaff-cutter. It can draw a plough, and most other farm implements." This report emphasises the intention that Land Rovers were designed to do light tractor work and the idea was not a silly one, even if the vehicle itself and its developments had many shortcomings in farm use. Today, however, there are lots of light tractors used abroad and on livestock and dairy farms in U.K. The differences between these tractors and the early Land Rovers are many and various. Land Rovers have 3 seats, 4 WDrive, suspension and some bodywork capable of carrying 10cwt in an area of about 14.5 x 34 inches. Light tractors have one seat, are 2 WDrive, have no suspension and no bodywork for carrying weight but they do have a 3 point linkage for carrying purposes and a one or two speed power take off. Early Land Rovers could pull a trailer of 2 to 3 tons at 40 mph, which is considerably quicker than that currently hauled by most light farm tractors.

Land Rover product development contrasts markedly with developments in light tractors but the Land Rover was evaluated by Britain's tractor testing station, N.I.A.E. (Silsoe Research Institute), and a comprehensive report written of No.32 and No.33 Land Rovers (which did not have a central driving position). NIAE ploughed, harrowed, rolled, and reaped but also hauled a power take off driven muck spreader with it and reported approvingly of its ploughing and power take off performance.

The evidence of 50 years of customer usage contrasts somewhat with this optimism. In reality, the 3 point linkage and the power take off were rarely used by farmers but Land Rover's ability to operate with trailers (for carrying one horse at a time or half a dozen pigs/lambs) whilst also taking 3 passengers and a couple of small items (10 cwt) in the back has become significant. Farm tractors, on the other hand, are frequently seen hauling much larger trailers at a maximum legal speed of 32 km/h (20mph).

### **RURAL TRANSPORT VEHICLES (RTV) IN CHINA, INDIA AND MIDDLE EAST**

In the overseas countries of Africa and the Middle East large numbers of Land Rovers are used but in China and India they are a rare sight. Jeeps are still used in



large quantities across India and in China a vast number of different RTV's (rural transport vehicles) with 3 and 4 wheels are in use. The R&D work at Land Rover in the 50's and 60's was particularly relevant to the current needs of China and India but it has not yet been appreciated that a vehicle such as the Agrover (a Land Rover with additions for farmers) based on the 110 Series Defender is close to what would be much appreciated in the four wheel RTV market of China, where there were over 140 different factories producing four-wheeled RTV's.

At Land Rover, before Ford ownership, farmers bought the 90" and 110" Land Rover with much improved diesel engines for about £10,000 and these vehicles eventually became the Defender range. The new Land Rover caused farmers to consider them again, for light work with trailers and horseboxes, where the 3 ton trailers, of Ifor Williams and others, presented few repair problems and a reasonable level of economy with diesel power. The Land Rover could support tractors and take over some of the lighter and potentially faster power-take-off and linkage work of tractors and could certainly be used for spreading, spraying, fencing and mowing grass. Spotting a potential market, a Lancashire-based design engineer decided to design a version of the Land Rover, which had a powerful power-take-off with accompanying independent clutch and a category 1, farming, 3 point linkage (to control the mower etc.) along with higher clearance axles and demountable body, so that farmers would have their Land Rover but also have a useful vehicle for some light, p.t.o. and linkage work. They called this vehicle the Agrover (see [www.lr-mad.co.uk](http://www.lr-mad.co.uk)).

#### **WIDENING THE SCOPE OF LAND ROVERS IN FARMING**

The Agrover (1985) demonstrated the significance of widening the scope and use of Land Rovers in the direction of tractors. W.S.H. Taylor's Series 1 Trantor tractor prototypes at [3] 80 H.P. (1979), which had Cat 2, 3 point linkage and 35 H.P. at the non-live p.t.o. These early prototypes weighed 2.75 tons, had UNIMOG sized rear wheels (24") and Land Rover sized front wheels, and aimed, like Agrover, to come between the Land Rover and the tractor. They were also designed to carry people and goods and also conduct most but not all of the work of both. Their driving position was in the centre of the vehicle. A few customers appreciated the Series 1 Trantor prototypes because they conducted all the duties of a Land Rover, towed much bigger trailers, had a linkage and a useful power take off. Whilst the bigger rear wheels, of the 2 wheel drive prototypes appeared to give the product sufficient traction in wet fields, the absence of 4 wheel drive on early prototypes was not considered a

weakness by those who mainly drove tractors and trailers on wet roads and tracks!

By 1984, however, Stuart Taylor, had learnt some lessons, from his pioneering customers and from his team of marketing researchers, who studied what farming customers needed. Five 96 H.P. turbo-charged diesel-powered, 4 Wheel Drive Series 2 prototypes were then built and put to customer tests. Taylor introduced independent power-take-off, (giving about 70 H.P. at the p.t.o. to operate heavier farm machinery of a spreading, spraying and mowing equipment type) and a Cat 2., 3 point linkage. These Series 2 Trantor tractor prototypes weighed about 3.2 tons. British engineering design had by 1986 created the conventional Land Rover, the Land Rover with adjustments (Agrover) and various prototype Trantors to variable specifications. The relative power of the p.t.o. and the weights to be carried on the linkage as well as the trailer load to be hauled, could be assessed and any one of the 3 different options (developed from original Land Rover thinking) were available for research-based comparison.

#### **A VERY POWERFUL LAND ROVER (1984-2007)**

The weight of the Land Rover was about 2 tons and the Trantor prototype 3 to 3.5 tons. The retail price of a Land Rover 110 Defender was about £10,000, the highest specification Trantor prototype about £15,000 for the large 4 WDrive version. The Agrover was about £12,000 (UK prices).

The Land Rover always had an inappropriate p.t.o. and 3 point linkage for any substantial work in farming. When p.t.o. equipment for tractors became popular in the 1970's, the presence of an independent clutch was progressively more important. The Agrover of 1985 gave customers this important facility on a conventional Land Rover, along with a 3 point linkage! Whereas the Agrover (1985) had 45 H.P. at the p.t.o. and a category 1 linkage, the highest H.P. Trantor prototypes had Cat 2 linkage and were 128 h.p. x 2 WDrive with 95 H.P. at the non-live p.t.o. The trailer pulling ability of the Land Rover was not increased by the Agrover specification whilst the Trantor increased the haulage capacity from 3-4 tons to in excess of 12 tons at 30 m.p.h. on the road. This increase in loadweight was important because the work profile of many farmers (moving bales, fertiliser, crops and goods) demands that big trailers are used. Whilst all the above features are clearly important to farmer users, so is ground clearance. The Agrover and Trantor prototypes had similar ground clearance but the Land Rover less. Part of the Agrovers specification, which was even less appreciated by Land Rover Ltd., than the excellent and useful 3 point linkage and p.t.o., were the high clearance axles which Agrover's designer created in

order to help farmers and local authority customers achieve their main work task objectives. (The Land Rover company was part of British Leyland at this time and the company was not pro-active and did not support the Agrover - Rural Transport Vehicle concept).

### **SIMILARITIES AND DIFFERENCES BETWEEN 3 MEMBERS OF A VEHICLE FAMILY**

The Trantor concept was different to the Agrover, however, because it was specifically designed to conduct many more farm duties than Land Rovers and Agrovers. The transport duties of Land Rovers are passengers in the cab and up to 2 horses, or the like, on the trailers. The Agrover follows this but adds a small linkage and smallish p.t.o., less passenger-carrying and the same haulage capacity as the Land Rover. The Trantor concept is quite different for it is less focused towards passenger-carrying, although it has 3 proper seats in the cabin, and space for 4/5 more on the rear platform. It is more focused on the size of the trailer to be hauled, the size of agricultural equipment on the linkage and the greater power of the independently clutched power take off. In those regions where palm oil, sugar, cotton, maize, wheat, sisal, potatoes, carrots and fruits are hauled over long distances from field to mill, market or processing facility, the Trantor concept has clear advantages when a 10 Ton plus trailer-pulling tractor is needed.

### **FRAMES FOR FARM TRACTORS AND CHASSIS FOR VEHICLES**

The Land Rover chassis changed when the 2 Ton, 110 Land Rover emerged at 60 HP. Around this time the Phaser (1000 Series) 105 H.P. engine was available for tractors and the Unimog chassis was well proven as a 120 HP 4x4 off-road vehicle. Other firms in U.K. developing chassis for farm vehicles were Househam, Frazier, Clayton, Bateman, (Chumleigh, Devon), and Chavtrac (Pontypool, Wales). Most of these started their thinking with Land Rover strength chassis and developed stronger ones, modified ones or re-designed ones to accept bigger diesel engines. All these firms produced various kinds of chassis for working in the very familiar 4 equal wheels configuration of most 4x4 Off-Roaders. The exception to this rule was the new concept of Trantor which required a chassis, designed to have bigger wheels at the back (28" and 24") and smaller ones at the front (20") This is an unusual configuration, but is by no means one to easily dismiss for it is based upon the well-established farming view that bigger wheels at the rear make sense because more weight is usually placed there, by farmers, the users of farm tractors!

### **WEIGHT CONSIDERATIONS- SO VITAL FOR THE FUTURE**

In farming, the weight placed on the rear body plus any residual trailer weight on the hitch/axle of the prime mover is considered significant to the overall design. [4] Pulling military equipment, hauling trailed bowsers and conveying spares on a trailer (e.g. in the Peking Paris Overland trek) are examples of special high speed trailer operations. There are many special trailers used around the world and some, in Brasov, Romania, and Rajasthan, India for example, pull passenger-carrying (bus) trailers.

From the chassis (frame) point of view, "four equal-wheels carrying not hauling (pulling) the weight" is usually the concept adopted e.g. Unimog, whereas the "unequal wheelers" prefer to pull the weight (on a trailer) and carry about 3/6 people and a little tackle (0.75 ton) on the body!



**Figure 4** : MB Trac in Ploughing Mode

The Chavtrac (equal-wheels) has a stretched chassis beginning at Land Rover size and making it a special chassis as strength needs changed. Chavtrac made their own chassis in their own factory and made many changes! The Chavtrac usually had no suspension and was therefore slow! Their recent thinking is also towards 4 wheel steer for more manoeuvrability. The Bateman, however, has suspension and 4 wheel steer and whilst it also has its own chassis they designed and developed it toward a more specialised up-market, crop-spraying specialist. The Clayton's (now Multidrive) chassis is also 4 wheel steer and attractive, however, due to it having suspension. Agribuggies were geared to lighter weights and used 90 H.P. Ford engines! From the concept point of view, chassis design depends on the engine power, the wheelbase and whether the load is to be carried or pulled (by trailer), amongst other considerations.

## LONG WHEEL BASE VEHICLES OTHER THAN LAND ROVER

As part of the research for this paper, the technical specification of the Stonefield 4x4 was examined and the vehicle experienced on its Cumnock test track. OKA in Australia was also visited to see the OKA (4x4) and its Indian derivative at its RTV factory, in M.P. (Pithampur). The wheelbase has been elongated on Forward Control Land Rover's, OKA's and Stonefield's compared to the Short Wheelbase (SWB) Land Rover, in order to cause "carrying lots more weight" to be a selling feature. Shorter however, may provide a better combination for carrying the load and hauling (towing) the load. The parallel policy for Range Rover explains, "the results of a market survey showed an upsurge in the leisure market and a greater requirement for passenger-carrying (as opposed to load-carrying) vehicles". This was considered as a much more influential business strategy at Rover Ltd. than "Developing the Land Rover" in the direction of farm tractors such as that of the Roadless Traction big wheel Land Rover. (Forest-Rover). The approach of Steyr-Daimler-Puch, Stonefield, Volvo, Fiat, Isuzu, Ford, G.M., Jeep and a whole lot more including Range Rover, Defender, Discovery and Freelander has been towards carrying people, rarely pulling light trailers and never pulling heavy trailers. It is interesting too, to note, that all of the special-purpose spraying machine manufacturers have extended their wheel bases and retained 4 equal wheels. This includes the Fastrac, which was not designed to carry as much as the MB Trac or Unimog and is therefore something of a surprise, for the conventions of all modern ploughing-first tractors are not equal-wheeled focused at all.

## SOMETHING DIFFERENT - FOR HAULING THE LOADS IN FARMING

It was not until 1973 that a British vehicle concept, based on Off-Roader thinking, would appear that was similar to early Land Rover's central driving position and one seat on either side of the driver!! Although this vehicle was created with some common Land Rover parts, including its front wheels, steering etc. it had 20" Unimog-type wheels and tyres at the rear. This vehicle concept [5] was very similar to the central drive Land Rover prototypes but had a 55 H.P. Perkins 4.154 diesel engine and was designed to tow a trailer of 4/5 TONS at normal road speeds. This rural vehicle concept, in which axle location systems in the chassis and a self-levelling pick-up hitch must be considered, is that pioneered and originated (with two patents) by its Trantor Design Team in UK, because, in farming, it is not usual to expect to support as much weight on the front axle as the rear, because in-field work with trailers and implements demands bigger rear wheels than front ones!

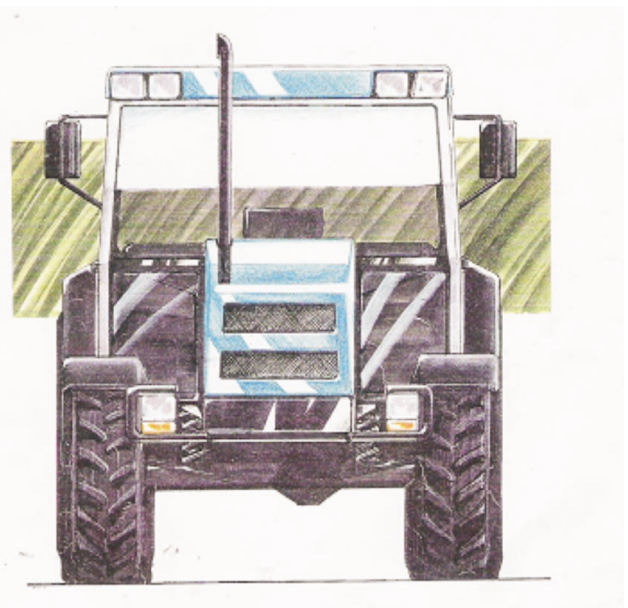


Figure 5 : The World's First 80 km/h Tractor

## SOME GERMAN IDEAS AND CONCEPTUAL THOUGHTS

Mercedes-Benz have been a very important and particularly significant influence on vehicle design in the post-war period. The G.Wagon, the Unimog and the M.B. Trac were the broadest and best range of off-road vehicle concepts in the world until the end of the 80's when the M.B. Trac was dropped. Independent tractor and vehicle minds seem no longer to exist in the German-off-road and tractor industries. Focus-groups and "market share next week" seem to be more powerful forces than fundamental innovation. Why else would it be raining so hard in Germany and the German farmers be saying - "My tractors are too-heavy for work in my wet fields!" Massive H.P. and massive weight is not much good if the tractor has to stay in the barn!



Figure 6 : Intrac from Deutz



CBeing English, it is not unusual to hear the view that German engineers are not good at concepts whilst there is a frequent, if reluctant acceptance, that they are masters of detail! In the most recent German conceptual paper on farm tractors, there are 5 concepts, which make little allowance for or reference to pulling the weight, for the German researchers seem already to have decided to carry it! The Fendt family (before Agco) was very significant and progressive but the independent-minded owners of this relatively small and innovative tractor business left the company. The managers were largely absorbed into US-owned Agco and big company bureaucracy was part of the reason for less innovation at this great German engineering concern. Also, in the case of the excellent MB Trac, the independent-minded Gaggenau-based Mercedes-Benz team simply handed their product range and innovation to the very conservative, old-fashioned, dyed-in-the-wool Koln-based, Deutz tractor company. Since Deutz and its professional elite were changing their Intrac in the M.B. Trac direction, after failing to come up with a sensible Systems tractor themselves, one could have expected that this valuable gift would not be the saviour they needed but an additional nail in their coffin. Bankruptcy, of course, resulted and rationalisation and downsizing became the policy of the buyers of the carcass! The Intrac and M.B. Trac disappeared with the failure of Deutz tractors (KHD) which was eventually bought by Same of Italy.



**Figure 7** : A Fendt – Xylon Showing Versatility

The Eurotrac from Schluter and Xerion from Claas were launched from a design approach not too far away in concept to the M.B. Trac. Later, the Fendt XYLON and Claas Xerion Mark 2 became the new concepts from Germany. At some time in the history of German tractor development, the manufacturers let the academics from

Munich University in on the act. More sophistication followed with more weight and incremental innovation and even more weight being the law of the situation. The kind of duties that are to be performed, the duration and timing of the work tasks, the implements to be used seem to be forgotten or not considered at all!!

## CONCLUSIONS AND CONCEPTUAL THOUGHTS

All of the vehicles and tractors mentioned here have some useful place in farming and for work as tractor replacements. The question is not therefore, are these vehicles useful. They are. The question is how useful? How many hours of highly productive use can be found for them over a normal farm-working year? Nobody thinks farm tractors are better driven slowly, if the quality of their work can be done at higher speeds. Lots of people do not understand how to pick horses for courses and still fewer have analysed their annual work load profile [2] and ask - "Is there something better and more efficient for these work tasks"?

Work task usage times in the farming calendar (Appendix 1B shows typical UK farmer's work task profiles) gives some clues as to how many and what kind of farm tractors and rural vehicles are needed now and in the future. Some tractors are likely to be ploughing-first, many should be transport tractors, many should be 4x4 pick-up trucks with and without linkage and p.t.o.'s. There will be some higher speed special-purpose sprayers with better and higher speed transmission systems. They will be expected to carry weight on the vehicle and most will be expected to have the hi-clearance facility. One thing is clear, if the rural farm vehicles of India (ox-carts, jeeps and tractors) and China (140 different 3 and 4 wheel vehicle factories) are as important as they clearly are, the rural vehicles of tomorrow will be more jeep and tractor influenced than ever before.

In Europe, in 2008, some changes for the better health, safety and performance of farm tractors seems, at last to be a possibility? The writer's 30 plus years of experience in [5] India's automotive sector has begun to acknowledge [6] that India can do much better by not, slavishly following Europe in its tractor and farm vehicle development. Perhaps the most significant conclusion of all is that made by Professor David Crolla of Leeds University, UK - "Two main types of tractors are needed in future (1) is the ploughing-focused Rubber-tracked challenger type, e.g. of Agco-Challenger tractor which tip toes over the land and the other (2) is a fully-suspended, light-weight (fuel efficient) transport and low draught tractor (like the Trantor tractor).





**Figure 8** : Trantor with Hi-Speed Grain Trailer

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