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## TRAIT-TAKING VERSUS TRAIT- MAKING IN TECHNICAL CHOICE: THE CASE OF AFRICA

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For a variety of different industrial sectors and across a range of different countries in sub-Saharan Africa, there is clear evidence that labour-intensive techniques generate not only substantially more employment than their capital-intensive alternatives, but more value-added as well.<sup>1</sup> There is just as much evidence, on the other hand that governments in the region tend to favour the latter over the former in those same sectors.<sup>2</sup> This apparent loss in output and employment was particularly important in the 1970s and early 1980s when the state occupied so dominant a position in the manufacturing sector of most African countries. Our purpose in this paper, however, is to suggest that the technological behaviour over the period in question was not as irrational as it is often depicted, because as we see it, the existing literature tends to ignore a crucial ‘third dimension’ of the choice between capital and labour-intensive techniques that then confronted decision-makers in the public sector. And although the bulk of the paper is addressed to the historical period of dominance by the state-owned sector, we shall nevertheless also suggest that the issues in question remain relevant in the 1990s, in spite of the many reforms that most African countries subsequently underwent in connection, largely, with the process of structural adjustment.

Our discussion will be cast mainly in terms of Hirschman’s concepts of ‘trait-taking’ and ‘trait-making’, because they reflect so keenly the issues on which the choice of technology in the public sector actually turn. ‘Trait-taking’ refers to a decision to accept some traits of a technology (or project) as ‘temporarily unchangeable aspects of the environment’, whereas ‘trait-making’ refers to a decision to change existing traits of a technology (or project). In these terms, what we shall argue below is that:

- (i) labour-intensive techniques often demand more trait-making, in terms of organizational and entrepreneurial capabilities, than is usually thought necessary, because in practice the choice is not between a single large-scale, capital-intensive plant and a single labour-intensive alternative, but rather between the former and a large number of small-scale plants;

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<sup>1</sup> See for example the studies reported in Pack (1982) and more recently the work of Bagachwa (1992) on Tanzania and Ahiakpor (1986) on Ghana.

<sup>2</sup> This literature is reviewed most recently by James (1995).

- (ii) large-scale capital-intensive techniques also require trait making (in the form of skilled workers, managers and so on), but these techniques, for various reasons, lend themselves far more readily to trait-taking than is the case with small-scale alternatives;
- (iii) in combination these hypotheses suggest that public sector decision-makers will incline towards capital, rather than labour-intensive techniques, though in the latter part of the paper we do describe a case in the public sector of one particular African country where the opposite choice was made. This case, too, we believe, can usefully be explained in terms of the concepts of trait-taking and trait-making.

### THE NEGLECTED THIRD DIMENSION

The literature already referred to is generally conducted in a two-factor world where the only dimensions of technical choice are capital and labour. In this textbook world, there are a number of reasons why public-sector decision-makers may not select the labour-intensive method of production even when it is more efficient (at market and shadow prices) than the relatively capital-intensive alternative. It is often argued, for example, that managers of public enterprises have objectives that conflict with economic efficiency or that engineers have a professional bias in favour of modern technology for its own sake.<sup>3</sup> It is not our contention that arguments such as these are incorrect; on the contrary, they have considerably enhanced our understanding of technological behaviour in the public sector. Our point is rather that there are additional dimensions to the problem that simply cannot be captured in this two-dimensional framework.

These additional dimensions begin to emerge once one considers the way in which decisions are actually made with regard to the choice of technology in sub-Saharan Africa. For whereas the existing literature usually pertains to the choice between an equivalent number of plants with varying factor intensities, planners in that region typically face a very different choice. Underlying the actual process is the selection, initially, of an incremental amount of output and it is the determinants of this planned amount that first need to be understood. In particular, what most fundamentally needs to be recognized is that there are a number of reasons why the planned level of additional output is invariably at least as high as the capacity of a single relatively large-scale and capital-intensive factory.

One reason is political and has to do with meeting national excess demand for key wage goods as rapidly as possible. Barclay, for example, has referred to 'Kenya's commitment to meeting the consumer demand for sugar by attaining self-sufficiency in its production' (1977, p. 62). 'Satisfaction of consumer demand', he argues, 'has remained a high political priority for the government'. Another reason is that planned increases in industrial output are often based on feasibility studies and sector reports conducted by external consultants who have a vested interest in the sale of large-scale imported machinery. In Tanzania, for example, what [the sectoral textile company] Texco did was 'in effect to entirely hand over its sectoral planning responsibilities . . . to a foreign consulting organization . . . the Gherzi Textile Organization of Zurich was commissioned to examine the whole industry. Its report was accepted in its entirety

<sup>3</sup> The former is discussed by Niskanen (1973) and the latter by Wells (1975).

Table 1. Capacity in Tanzanian Manufacturing, 1976 and 1980.  
 Source: ILO (1982, p. 219).

	1976	1980
Textiles (million sq mt)	90	200
Cement ('000 Mt)	340	1,100
Shoes (million pairs)	6.0	14.0
Leather (million sq ft)	11.8	32.5
Sugar ('000 Mt)	115	195
Containers (millions)	63.5	196
Hoes/ploughs ('000 Mt)	1.2	3.0

and used by Texco as the whole content for its sectoral 5 year plan and this in turn was incorporated lock, stock and barrel into the national plan ... The report in fact suggested a massive expansion programme' (O'Brien, 1983, p. 171). Similarly, in the Ivory Coast, Mytelka has observed how 'feasibility studies for the sugar complexes were prepared by their expatriate promoters, based on exaggerated expectations of ... both domestic and world sugar consumption' (Mytelka, 1992, p. 249). Finally, there is the influence exerted by Hyden's argument that 'African leaders have wanted to make historical shortcuts' (Hyden, 1983, p. 123). Such leaders, that is to say, have sought to replace conventional stages of development with deliberate and rapid structural changes in the economy. Hyden aptly refers to this style of development as 'running while others walk'.

In combination, the three influences mentioned in the previous paragraph have often given rise to increases in planned capacity that were large relative to pre-existing levels. Table 1, for example, shows the increases in capacity for a selected group of manufacturing industries in Tanzania between 1976 and 1980.

The reason why examples such as these are important for our purposes arises in conjunction with the fact that capital and labour-intensive techniques are not usually associated with the same number of plants in the production of a given level of output. On the contrary, as shown in Table 2 for a selected sample of industrial sectors, a single capital-intensive plant requires a larger, and in some cases a much larger number of labour-intensive plants to produce the same level of output.

For the point is then that as long as the planned increase in output is equal to at least the capacity of a single large-scale plant, further dimensions enter into the choice of techniques in addition to just the two traditional factors, capital and labour. In particular, not only will more entrepreneurs be needed to run the additional labour-intensive units of production, but those additional units will themselves impose organizational demands on the public sector.<sup>4</sup> And it so happens that in much of sub-Saharan Africa both entrepreneurs and organizational capabilities in the public sector are in particularly short supply. In relation to Tanzania, for example, Clark has argued that 'capital is not the most scarce resource. Rather, both entrepreneurs, people with the ability to initiate projects, and managers, people with the ability to operate them, are in short supply'<sup>5</sup> (Clark, 1978, p. 212).

<sup>4</sup> In Pack's (1982) study of the macroeconomic effects of switching from capital to labour-intensive methods of production this problem is simply assumed away i.e. he assumes 'that the supply of managers and operatives is sufficient to enable a large number of smaller plants to be established simultaneously' (Pack, 1982, p. 6).

<sup>5</sup> Clark (1978) emphasizes that the problem may not exist or be less severe in other regions, such as India.

Table 2. Number of labour-intensive plants to produce output equivalent of one capital-intensive plant. (*Sources:* Kaplinsky (1990), Green (1978), Kaplinsky (1987), Bagachwa (1992), Roemer *et al.* (1976), respectively.)

Sector (country)	Number of plants
Bricks (Botswana)	
Capital-intensive	1
Labour-intensive	11
Bread (Tanzania)	
Automated	1
Labour-intensive	50
Sugar (Kenya)	
Vacuum-pan method	1 <sup>1</sup>
Open-pan method	
100 tons	81
200 tons	41
Maize milling (Tanzania)	
Maize roller (120 tpd)	1
Maize hammer (4 tpd)	30
Footwear (Tanzania)	
Large-scale	1
Small-scale	142

<sup>1</sup>Equal to 1.3 plants.

In the graphical Appendix to this paper, we try to clarify the argument just advanced, by comparing the situation where labour-intensive techniques demand the making of certain traits, with the way in which this dimension of such technology is usually neglected in the literature (based as it is on only two dimensions).

#### TRAIT-TAKING VERSUS TRAIT-MAKING IN THE CHOICE OF TECHNOLOGY

So far we have focused on certain important, but neglected technological capabilities that would be associated with the choice of labour, over capital-intensive methods of production. But it is also true of course that the latter are themselves demanding of technological capabilities (albeit of a different kind) that are just as scarce in the African context. Indeed, it is precisely these demands (for managers, skilled workers, engineers, etc.) that have long led numerous economists to question the appropriateness of such techniques not only to sub-Saharan Africa but also to developing countries more generally. What distinguishes capital, from labour-intensive techniques in this regard, however, is that the former lend themselves far more easily in actual practice to what Hirschman (1967) describes as 'trait-taking'. By this he means a decision to accept the short-run impossibility of generating the necessary capabilities locally and importing them from abroad instead. He contrasts this type of behaviour with 'trait-making', which entails an explicit decision to change existing, or create entirely new traits. (The relative ease of trait-taking by importing in the case of capital-intensive techniques is due, in part, to the far more numerous possibilities

of obtaining foreign finance with these types of techniques, via, for example, foreign aid and suppliers' credits.)

As reflected perhaps most clearly in the popularity of large-scale turnkey projects in manufacturing,<sup>6</sup> it is fair to say that with few exceptions planners in sub-Saharan Africa have opted for a combination of capital-intensive techniques and trait-taking (via importation of the necessary capabilities), over the combination of labour-intensive methods and trait-making (where the traits to be made are the scarce organizational and entrepreneurial capabilities referred to earlier). In Côte d'Ivoire, for example, a study of the cement industry financed by UNIDO recommended the production of cement block which 'is less import intensive than cement, uses large quantities of cheap laterite clay, can be produced in small decentralised units thereby decreasing the cost of building materials and of investment costs at the same time as it increases employment'. However, 'The scarcity of public funds and *the lack of artisans to staff these small enterprises seriously constrain the government's ability to implement this programme*' (Mytelka, 1992, p.262, emphasis added). Similarly, in the case of Tanzania, the problem with producing sugar on the basis of small-scale (open-pan sulphitation) plants was that some 200 such plants would have been required to replace the output of five large-scale ones. The managerial and supervisory problems associated with the former, as well as the training of operatives in the OPS method and the difficulties of raising finance for small-scale, labour-intensive techniques all strongly mitigated against its use (James, 1987). That the combination of capital-intensive techniques and trait-taking should enjoy such popularity is thus not difficult to explain. After all, in this as in other contexts, trait-taking has an obvious appeal, offering as it does the prospect of a reduction in the various uncertainties that attend the construction and operation of development projects. Trait-making on the other hand, suffers by definition from the absence of these advantages and is subject instead to considerable doubt and uncertainty regarding the course of development projects.

Consider, for example, how these considerations bore on the choice of an automated bakery in Tanzania, which, to many observers at the time seemed like highly inappropriate technology in comparison with the alternative hand-baking technology. For, not only did the latter save on the cost of capital but it also reduced import costs in comparison with the former. And since the spare parts and replacement machines associated with hand bakeries could have been locally produced, this technology could also have helped to promote the local capital goods sector. The problem, however, (or at least a major part of the problem) was that the hand bakeries would have required a substantial amount of trait-making. That is:

in the absence of a pool of hand baking expertise and of successful producer cooperative experience generalizable to new ventures getting 40/50—as opposed to 2 to 4—bakeries running with a minimum degree of effectiveness even over 3 to 4 years would have involved training and support of a type which Tanzania was quite incompetent to provide (Green, 1978, p.18).

The large-scale, automated bakery, on the other hand was financed by Canadian aid and the turnkey arrangement with which the project was associated allowed the missing local traits, or capabilities, to be 'taken', via imports, rather than requiring

<sup>6</sup> For the case of Tanzania, Wangwe (1986) found that most turnkey projects occurred in the public sector.

them to be 'made'. The problem in this case, however, as indeed in many other similar cases in sub-Saharan Africa, is that trait-taking by importing becomes 'trait-reinforcing' (to use Hirschman's term). That is to say:

the local people whose inability to perform certain tasks is taken for granted and as unchangeable may come to be systematically excluded ... from the skilled positions and occupations by the newcomers who will acquire an interest in being retained as 'indispensable' in the elite positions they have come to occupy. Similarly, imports of needed material inputs may discourage or destroy any incipient local production. These are familiar mechanisms, well described by the concepts 'cumulative sequence' and 'self fulfilling prophecy' (Hirschman, 1967, p. 132).

That imports of large-scale, capital-intensive technologies by state-owned (and other) enterprises in sub-Saharan Africa have been associated with this tendency to stunt rather than promote domestic technological capabilities (the traits in extremely short supply), is a popular refrain among industrial economists. In the case of the Ivory Coast, for example, Mytelka concludes that the reliance by the public sector on foreign capital and suppliers has 'had little impact on the building of indigenous technological capabilities through the technology transfer process' (Mytelka, 1985, p. 87). Similarly, of Tanzania it has been said that:

In the process of implementing turnkey projects the local manpower is 'freed' from participating in those preparatory and investment decision activities which have considerable learning effects ... This way the opportunity to increase the supply of managerial and technical skills through learning-by-doing is foregone (Wangwe, 1986, p. 15).

Observations such as these have given rise to numerous suggestions as to how imports of modern technology can be made more compatible with trait-making behaviour (that is, with the acquisition of indigenous technological capabilities).<sup>7</sup> What has received much less attention, however, is the process of trait-making in the (large-scale) application of *labour-intensive techniques* in sub-Saharan Africa, a process, that, as noted previously, has to do with organizational and entrepreneurial capabilities. In what follows we discuss these issues with particular reference to the Rural Access Roads Programme in Kenya, where labour-intensive technology was successfully applied on a large scale in the public sector.

## **TRAIT-MAKING FOR LABOUR-INTENSIVE TECHNOLOGY**

### **Hirschmanian Latitudes**

As already noted, trait-making behaviour in general runs the risk that the traits which are lacking and on which the success of the project depends, will not in fact be 'made'. 'Under what conditions' then, asks Hirschman (1967, p. 135), 'is the risk sufficiently

<sup>7</sup> See for example Stewart *et al.* (1992). There is also a more general literature on 'unpackaging' imported technology. See for example Stewart (1979).

small that trait-making becomes a practical possibility?' 'The most obvious answer' be believes,

is that many traits, from simple skills to administrative ability, can be slowly learned 'on the job' or alongside it. The fact that these traits are not yet available in the desired quantity and quality at the inception of the project can mean simply that the cost of construction and operation of the project should make allowance for the inevitable learning process to which outside education and training will of course be expected to make an important contribution. It is precisely because much trait-taking proceeds through gradual 'on the job' learning that latitude for poor performance can be a welcome attribute of projects (Hirschman, 1967, p. 135).

Performance latitudes may take at least two forms: one having to do with time and the other having to do with product quality. Temporal latitudes make specific allowance for the extra time that is needed for traits to be made during the course of development projects, whose average duration will thus tend to be longer than similar projects engaged in trait-taking technological behaviour. Product quality latitudes recognize not only that the period during which traits are being made may entail temporary problems in attaining high standards, but also that labour-intensive techniques are often themselves incapable of producing precisely the same product characteristics as capital-intensive technology (among other reasons, because of the greater degree of engineering precision that the latter is able to achieve).

Both types of performance latitude, we should note, played a role in what is to date perhaps the most important application of labour-intensive techniques on a large scale in sub-Saharan Africa, namely the Rural Access Roads Programme in Kenya (which has built thousands of kilometres of access, and more recently minor roads, on the basis of labour-intensive methods of construction).<sup>8</sup> Consider first the temporal latitudes that were granted to this programme in the name of trait-making (that is, on the basis of an explicitly recognized need to develop the technological capabilities associated with the use of labour-intensive technology on, what, at the time, was an unprecedented scale). In particular:

The programme had a very slow build up . . . Thus in the first 3 years output was low. This was a result of a quite deliberate policy decision. It was recognized that this was a totally new programme for Kenya using a technology which was not widely understood. Time was therefore required to modify and adapt the existing procedures and to develop a suitable training programme (Edmonds and Ruud, 1984, p. 15).

During this trait-making phase (from 1975 to 1980), the Roads Programme in Kenya was provided with considerable expatriate support. By 1980, however, after significant trait-making had indeed taken place among the local labour force, the foreign presence was 'drastically reduced both in quantity and orientation' (Edmonds and Ruud, 1984, p. 16). Evidently, the gradual learning that Hirschman thought possible when a degree of latitude is present, can be accomplished in sub-Saharan

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<sup>8</sup> The choice of technique in road construction is similar to the examples cited above from the manufacturing sector, in that the labour-intensive alternative involves spreading a much larger number of labourers over a wide terrain, with a consequent need for supervisory and organizational capabilities.

Africa under certain circumstances. (See also below the discussion about replication of the Kenyan experience.)

The Roads Programme also exploited the quality latitudes that are available in the construction (and maintenance) of access and minor, as distinct from main roads. Because the former are used much less intensively than the latter, for example, they permit a greater degree of tolerance in horizontal and geometric design standards. Access and minor roads, moreover, need to be built with a lesser degree of precision than major roads and there is correspondingly more scope for labour-intensive methods in the former than in the latter. In regard to the 'compaction of earthworks and the final surfacing' for example 'it is true that it is extremely difficult to provide the same standard using labour-based methods'<sup>9</sup> (Edmonds and Howe, 1980, p. 18).

In many other cases in Kenya, as elsewhere in sub-Saharan Africa, however, the scope for quality latitudes is unnecessarily restricted by the use of developed-country standards. Housing in Kenya, for example, is subject to building codes and standards that put houses subject to those regulations out of the reach of the low-income majority. On the other hand, housing constructed to lower standards would not only make basic shelter affordable to that majority, but it would also permit more labour-intensive methods of housing construction on a large scale.

### **Trait-making and Uncertainty**

As we have already seen, it is in the very nature of trait-making that the outcome of the exercise is subject to doubt and uncertainty, a consideration which we further suggested, helps to explain why policy-makers in sub-Saharan Africa have tended to favour trait-taking with regard to the capabilities aspects of development projects. If trait making is to be encouraged, therefore, some means of reducing the attendant uncertainty needs to be found.

What bears perhaps most emphasis in this regard is the scope for pilot projects to test the eventual likelihood of successful trait-making on a larger scale. The experience with the project on a small-scale, experimental basis, that is say, is used to gauge its probable success at a macro or national level. In this way uncertainty can be reduced (though of course not entirely eliminated) at relatively low cost. Such an approach was adopted in the Kenya Rural Roads Programme referred to earlier and it ought, according to Green (1978), also have been considered as an alternative to the automated bakery in Tanzania. In particular, he suggests that part of an alternative to the selection of that type of large-scale bakery would have been to 'identify and support a group (or groups) interested in creating one to three test cooperative, small scale, hand bakeries' and to 'experiment with ways of providing procurement and marketing services to the hand bakery' (Green, 1978, p. 19).

Where relevant, moreover, the design of pilot projects itself can benefit from the successful experience of similar countries elsewhere in the region, thus further reducing the uncertainties associated with trait-making behaviour. In this regard, the Kenya Roads Programme is once again illustrative of what can be achieved. I am referring here to the 'study tour' of the Programme that was initiated by the International

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<sup>9</sup> Product quality latitudes have been exploited in China's rural industrialization policy, as when, for example, low quality cement is used for dams with earthwork cores (Perkins, 1977).



Labour Office and the Kenyan Ministry of Works, mainly for engineers and economists from other African countries. The participants were given the opportunity to visit some of the field activities and to discuss the Programme with those officials most closely involved with it (van Veen, 1980). Since then, and based partly on that experience, a number of African countries (such as Botswana and Ethiopia) have themselves embarked on pilot road construction projects using labour-intensive methods (Edmonds and Ruud, 1984).

### **Decentralization within the Public Sector**

Because they often tend to be located in dispersed, rural areas, labour-intensive industrial techniques are most effectively administered through (and indeed may even necessitate) a decentralized, rather than a centralized public sector. It is unfortunate from the point of view of the trait-making that is needed with these types of techniques, that the state in most African countries is run along highly centralized lines. Indeed, for both internal political reasons as well as a tendency for foreign aid donors to bypass 'secondary structures in favour of relationships with central authorities' (Picard, 1994, p. 8), the African state is highly centralized even by the standards of the rest of The Third World (Table 3, for example, makes this point clear in relation to the shares of government employment in total nonagricultural sector employment by region).

Table 3. Share of government employment in total nonagricultural sector employment 1983 (in per cent). *Source:* Heller and Tait (1983).

	Africa	Asia	Latin America
Central government	30.8	13.9	20.7
State and Local government	2.1	8.0	4.2

That so extreme a degree of state centralization has hindered the trait-making needed for the extensive-application of labour-intensive technology, is well-illustrated by the bakery case in Tanzania, to which we have already alluded on a number of different occasions. For, whereas the large-scale automated bakery in that example was well-suited to the highly centralized manner in which the state was then organized in Tanzania, the 'real difficulty' facing the competing hand bakeries 'was that there was no evident decentralized public sector institution to operate [them]. Prior experience . . . had left both officials and politicians wary of proposing "green field" sectoral developments at the small scale, public sector level' (Green, 1978, p. 15).

It is true that since then, in Tanzania as indeed most other countries in sub-Saharan Africa, efforts have been made, mainly in the context of overall reform programmes to strengthen local governments. And in some of those countries progress towards meeting this objective has certainly taken place. As a result of the district focus policy in Kenya, for example, 'the financial management of district specific projects now occurs at the district level, more senior personnel are operating at the district level, and development committees have significant input at the project identification stage' (Oyugi, 1994, p. 93). Similarly, in Rwanda, 'the commune has emerged as an increasingly important institution for rural mobilization and participation and for the

negotiation of assistance from international donor agencies' (Bratton and Rothchild, 1994, p. 275). Overall reviews of the African experience, however, suggest that progress towards a more decentralized state has been rather limited. Garrity and Picard (1994, p. 156) for example, are not alone when they conclude that 'Throughout Africa, policy elites have been less than successful in decentralizing policymaking and administration ... Both decentralization and pluralism have foundered on lack of resources (physical and human) a lack of skills, and the lack of political will to commit to devolved, participatory government.'

To this extent, therefore, decentralization *itself* still remains very much a scarce trait and as such is subject to the same problems and opportunities (afforded, for example, by various types of latitudes) as other traits that still need to be 'made' in sub-Saharan Africa.

### **IS TECHNOLOGICAL CHOICE IN THE AFRICAN PUBLIC SECTOR STILL RELEVANT?**

One might reasonably wonder whether the issues raised above, which applied mainly to the circumstances prevailing in the 1970s and early 1980s, are still relevant in the 1990s, after the many attempts to curb the size and power of the public sector in sub-Saharan Africa. Indeed, there are some observers who seem to regard this sector and its problems as a non-issue under contemporary circumstances. In our view, however, this is a seriously mistaken point of view which is simply unsupported by the available data for most African countries.

In particular, two World Bank Reports published in the mid 1990s clearly indicate that in a number of African and other developing countries 'state-owned enterprises (SoEs) account for nearly as large a share ... today as twenty years ago. Indeed, ... the size of the state-owned enterprise sector has significantly diminished only in the former socialist economies and a few middle-income countries. In most developing countries, particularly the poorest, bureaucrats run as large a share of the economy as ever' (World Bank, 1995, p. 1). Since much of the historical evidence presented above, pertained to one specific African country, Tanzania, it is especially noteworthy that between the periods 1978–1985 and 1986–91 in that country, the share of state-owned enterprises in non-agricultural economic activity actually rose by almost 6 per cent (World Bank, 1995).

The continued existence of so large a public sector in many African countries has, to a greater or lesser degree, thwarted the emergence of a more prominent role for the indigenous private sector, which, also, still often suffers from a number of weaknesses, not the least of which is a lack of technological capabilities of various kinds.<sup>10</sup> And even such capacities as there are in the private sector are often underestimated by the prevailing highly centralized systems of government, referred to above.

An example of how capacities of local firms are often underestimated by central government ministries is provided by Burundi and Tanzania, where private

<sup>10</sup> There are, of course, some exceptions, one of the most interesting of which is the emergence in Tanzania and Zimbabwe of a low-cost, labour-intensive technology known as the ram press. With assistance provided, among other institutions, by Appropriate Technology International, 2,000 new small-scale privately owned enterprises have been created in these two countries. For further details see Hyman (1993).

sector firms have been contracted by local governments to build sections of roads even as their respective Highway Authorities were unaware of such activities and did not know that such private contractors were available with their own road equipment (Silverman, 1992, p. 12).

## CONCLUSIONS

In this paper we have argued that the existing literature on the choice of industrial technology in sub-Saharan Africa misconstrues the way in which the issue is actually perceived by decision-makers in the public sector. In particular, this literature fails to recognize that in practice the choice is frequently between a single large-scale plant and numerous smaller labour-intensive plants which would be needed to produce a level of output equivalent to that of a single, large-scale, capital-intensive factory making a similar type of product.

This recognition is important because the additional labour-intensive units of production require entrepreneurial and organizational resources that are extremely scarce in the context of sub-Saharan Africa, yet, which are ignored in the traditional two-factor description of the choice of technology. If labour-intensive techniques are to be used on a wider scale, far more attention needs, accordingly, to be paid to the problem of building up these capabilities than has hitherto been the case. (Expressed in Hirschmanian terms, the need is for more attention to be paid to the 'making' as opposed to the 'taking' of the traits in question.) By drawing on a number of case studies from sub-Saharan Africa—of success as well as of failure—we have described a set of policy measures that might be taken to redress this important problem. These include taking advantage of performance latitudes associated with certain projects (where the product duration and product quality variations are not critical to the outcome); reducing uncertainty by project experimentation on a pilot basis; decentralization within the public sector and decentralization to the small-scale private sector.

## APPENDIX: TRAIT-MAKING ASSOCIATED WITH LABOUR-INTENSIVE TECHNOLOGY

The Figure 1 depicts not only the two usual dimensions of technical choice, but also a third dimension, representing entrepreneurial/organizational capabilities. The latter, however, is associated with only one of the three capital–labour ratios we have identified in the diagram. The first two ratios,  $K_1L_1$  and  $K_3L_3$ , represent, we assume, the choice between a single large-scale, capital-intensive plant and one smaller-scale, relatively labour-intensive unit of production respectively. It can be seen that neither of these methods makes any demands on our third factor input and it is indeed precisely the choice between these two methods that is implicit in the existing literature.

The ratio  $K_2L_2$ , on the other hand, does demand entrepreneurial/organizational capabilities (equal to say *OR*) because it requires more than a single plant to produce the higher level of output associated with  $K_1L_1$  (on the isoquant II rather than the isoquant i). This distinction is shown more explicitly in Figure 2 which contains three

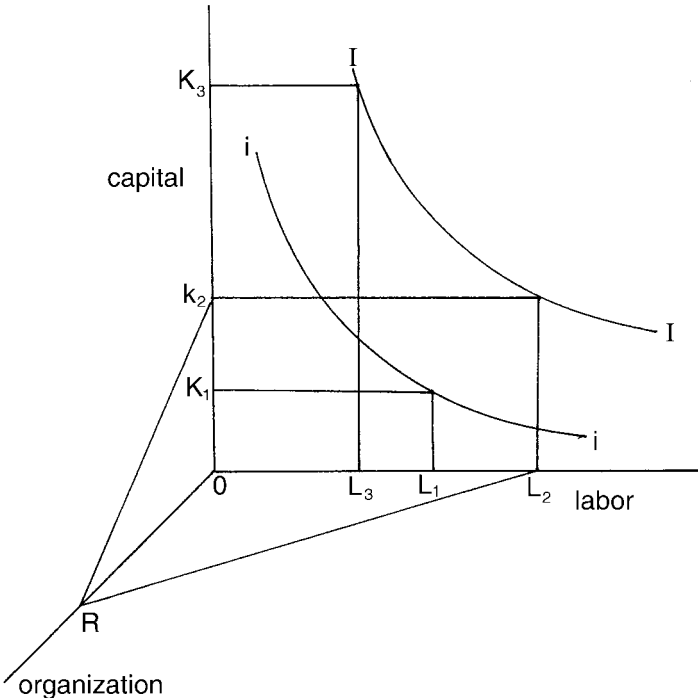


Figure 1. The choice of technology in three dimensions

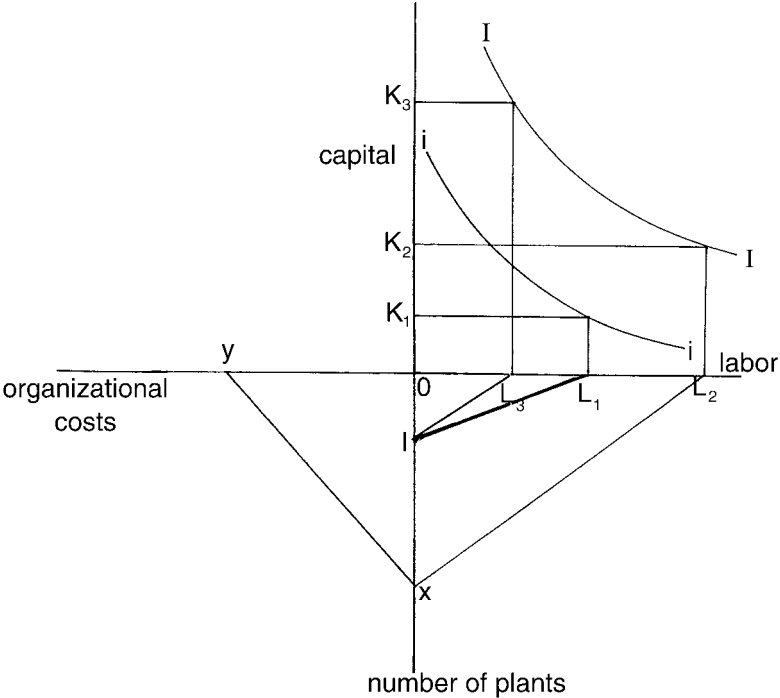


Figure 2. The relationship between factor intensity and number of plants

quadrants rather than three dimensions. The first quadrant contains the same information about capital–labour ratios as Figure 1 but the second quadrant indicates the number of plants that is associated with each such ratio. And whereas the capital-intensive and small-scale labour intensive methods,  $K_1L_1$  and  $K_3L_3$ , are associated (by previous assumption) with only one plant, the larger-scale labour-intensive technique  $K_2L_2$  requires a greater number, equal to say  $OX$ . The third quadrant, in turn, displays the extent of additional costs that are associated with technique  $K_2L_2$ , an amount which we have arbitrarily assumed in the figure to equal  $OY$ .

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